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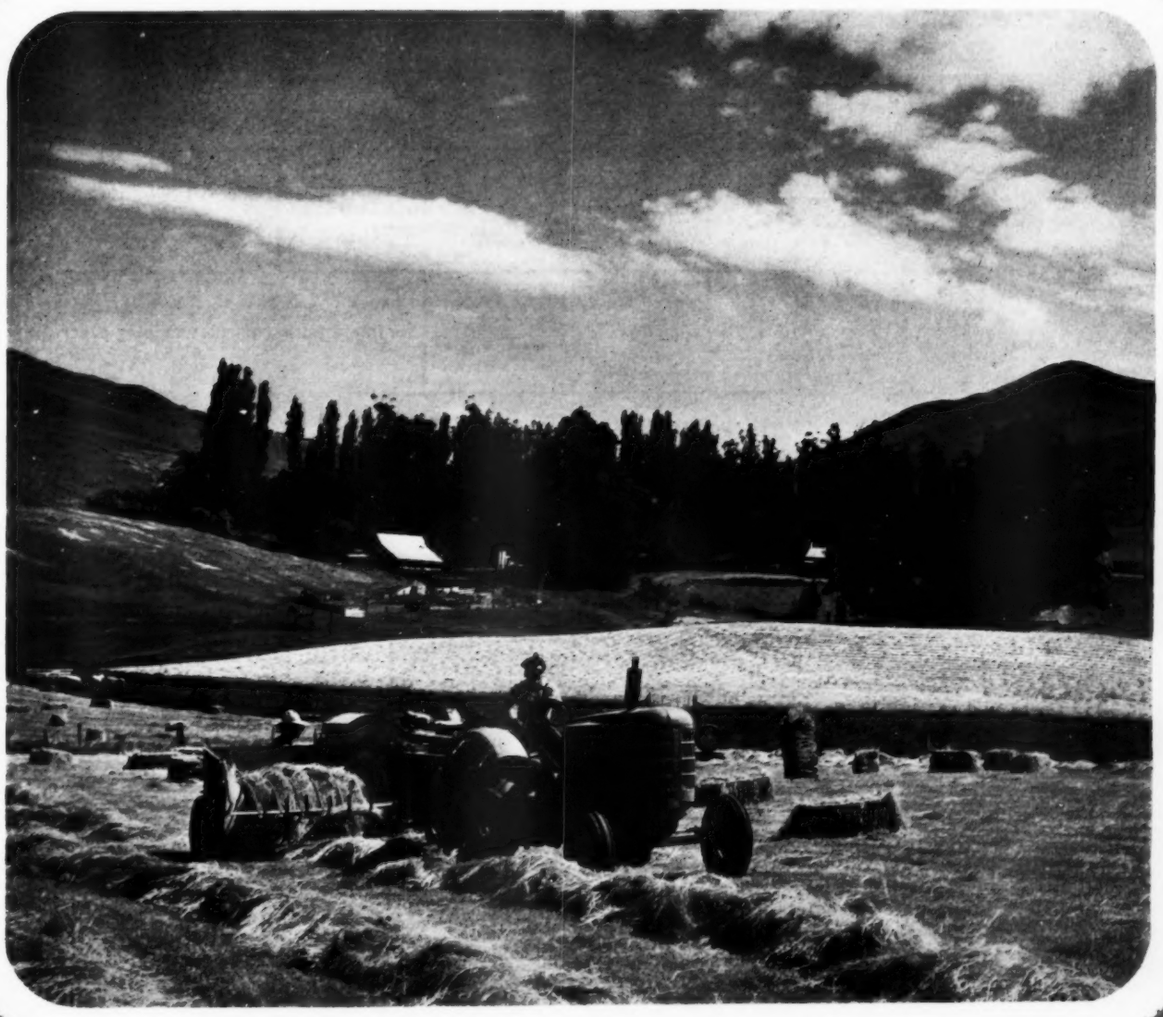

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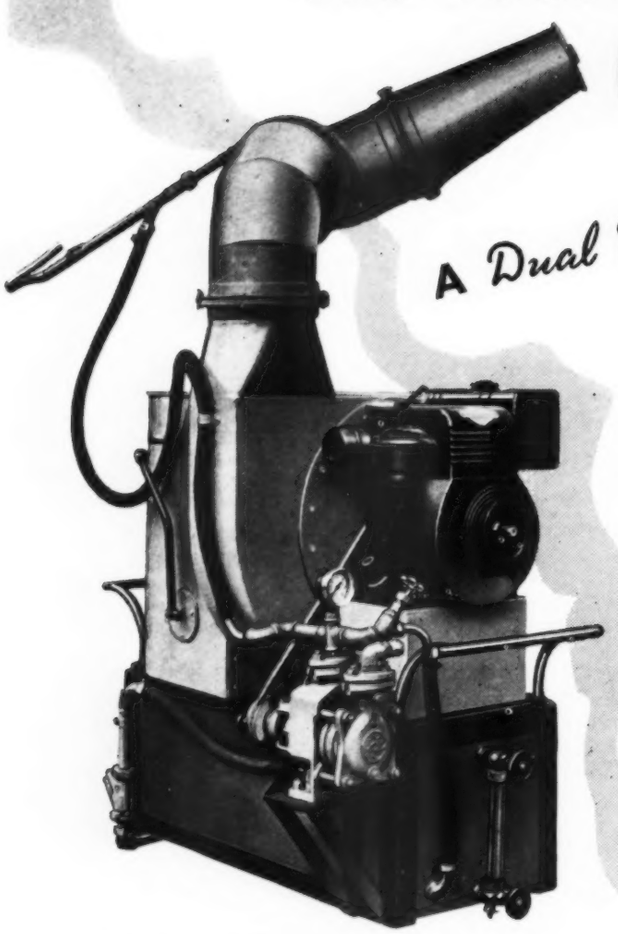

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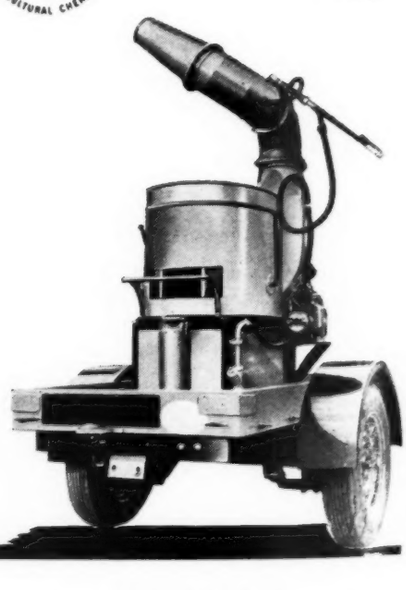

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Editorial Comment

Agricultural broadcasting

THE paper on agricultural broadcasting recently read by Mr. John Green before the Farmers' Club in London and the subsequent discussion gave welcome publicity to a matter of considerable importance. The broadcast word is the most powerful instrument available for reaching the farmer and the planter in his home and on his farm; it possesses enormous potentialities for bringing news to the farmer of the latest developments in technique, the course of market prices, weather conditions and the hundred and one things he wants to know about. Conjoined to and co-ordinated with other extensional activities it can exert almost incalculable influence and when, in the future, it is fully and completely linked with visual broadcasting through television, the possibilities almost defeat the imagination.

In Great Britain, although great progress has been made and agricultural broadcasts of great interest and importance are regular features heard by thousands of listeners, a handicap is that much of what goes out is on a nation-wide basis, owing to the paucity of regional stations. There is the consequent limitation of time and air space, bearing in mind that the great bulk of listeners are in urban areas and those who are professionally interested in agriculture are a mere 6% of the population. Moreover, as Sir John Scott Watson pointed out in the discussion, for a small country like Britain the diversity of farming in different localities is extreme, and there is great difficulty in planning a service which will be of interest to everybody. The fruit or hop farmer in Kent has little in common with the potato grower in the Fens or the hill sheep farmer in Wales or Scotland. Some parts of the country are, it is true, well served with regional services which allow broadcasts of local interest, but for something approaching one-third of the agricultural areas there is no regional service at all.

By contrast, in some other countries, particularly the U.S.A. and Canada, agricultural listeners are much better served. In these countries a feature is the abundant provision of small local stations capable of reaching only a small local audience but all linked together with a network of land lines. In the U.S.A. farm radio is the right hand of the extension services, and the country agricultural agent usually has a regularly booked telephone call broadcast with his territory every dinner hour.

Of course, in such territories the vast distances and the isolation of many farming communities have provided an incentive to develop intensively agricultural broadcasting on a regional basis, which is to an extent lacking in a relatively close-knit community like Great Britain. Nevertheless, the example is there for all to see and profit by.

Mr. Green's paper was concerned exclusively with broadcasting in English-speaking territories; he left untouched the question of broadcasting in other countries and in other languages. Let us hope, however, that in due course these too may be reviewed and studied on a comparative basis, since in this way only will it be possible to arrive at a full understanding of the methods and techniques appropriate to differing conditions, and enable the fullest use to be made of this potent weapon in the campaign for enhancing and improving agricultural production.

Forests as crops

TIME was when forestry was regarded as a thing apart and to the lay mind its connection with agriculture was remote and obscure. The importance of forests was obvious, since they provided the world's timber, while their value as a means of protection from floods and erosion and as suppliers of water have been universally accepted as the result of the disastrous experience which followed excessive removal of forest cover in many parts of the world.

It was for long more or less generally considered, however, that forestry was a somewhat recondite pursuit and that forest management and timber production were things apart from the ordinary operations of agriculture, requiring to be pursued on altogether different lines.

This view has now given way to the realisation that forestry is really a specialised branch of agriculture and its principal product, timber, is a crop just like any other, the main difference from other crops being that timber takes many years to mature. For this reason and because of the need for reducing cultivation expense when spread over a long period, the methods of the forester differ from those in other forms of agriculture, but essentially the problems are the same, namely ensuring satisfactory growth and yield and protecting the crop from harmful influences.

There is just as much need in forestry for attention to the factors which govern crop production as in the case of short-term crops. Forestry can benefit from the work of the plant breeder in producing improved and better types of timber trees by selection and hybridisation. It can also benefit from manuring, while forest soils present problems of high importance, as they represent a climax in soil evolution. Moreover, problems of pest control

in forests can be just as urgent and threatening as those of any other crop.

Point is given to the foregoing remarks by some observations of Dr. Wendell H. Camp of the Academy of Natural Science of Philadelphia at the 119th annual meeting of the American Chemical Society at Boston in April last. In appealing for a broad programme of reforestation in the U.S.A., Dr. Camp stressed the possibilities of breeding new trees and predicted a great revolution in this field in the course of the next few years which would restrict reforesting operations to the best and most suitable types, and adumbrated the possibility of producing new and more desirable types of forest tree by hybridisation of existing species. He also referred to the need for constant activity to fight the pests and diseases with which forests are likely to be beset, citing for example the damage already done in the U.S.A. by chestnut blight, Dutch elm disease and beech bark disease, the last named having recently invaded New England and New York from Nova Scotia where it is rapidly killing off the trees. Moreover, the oaks are now threatened by a fungus disease, first observed in the Mississippi valley in the 1930s. Until comparatively recently little attention was paid to it, but early in 1950 a large-scale attempt was made to assess the situation and it was found that the Chalara oak wilt, as the disease has been termed, had spread into Illinois, Indiana and the heart of Pennsylvania. There is little knowledge yet as to how the spores of the causal organism are spread and, as Dr. Camp remarked, one dare not predict with confidence what the future of the American oak forests will be.

Pelleted seed for reforestation

WHILE on this subject, interest attaches to some recent work in the U.S.A. on the re-establishment of forest rangeland by means of broadcasting seed from the air. In south-eastern Utah, Messrs. A. T. Bleak and T. A. Phillips have lately carried out a series of comparative seeding tests on about 8,000 acres of national forest rangeland in south-eastern Utah.*

The experiments were designed to test the possibility of aeroplane seeding and at the same time to ascertain whether broadcasting of pelleted seed gave superior stands compared with unpelleted seed. The pelleting of seed with a mixture of fertilisers and insect repellants and fungicides had given promising results with many agricultural crops and it seemed an obvious possibility that equally good results might follow the sowing of pelleted seed in reforestation. The soils on which the experiments were carried out were rather poor, light, sandy-loam soils which had been heavily depleted of fertility; similar broadcast plantings near the same area of natural seed in 1946 had proved successful with aspen and oak.

For the experiments a special pelleting process was developed by Dr. L. S. Adams, and three separate broadcasting trials were carried out. Unpelleted seed was broadcast at a rate of 10 lb. per acre and pelleted seed at two rates of, respectively, one and two pellets per sq. ft. Contrary to expectations, the unpelleted seed produced from 15 to 165 times as many seedlings per sq. ft. as did the pelleted seed, while all the pellet broadcast areas showed stands that were rated as very poor. Broadcasting pellets at twice the standard rate did not materially improve matters and it was concluded that pelleting resulted in reduced seed germination.

Climatic conditions were very favourable for seed germination and the reason why the seeds in pellets produced lower sprouting and emergence was not clear. It is suggested that the result may perhaps have been due to lack of oxygen in the compressed pellets. In any case the result is unexpected and illustrates how difficult it is to generalise from experience in one field to the specialised conditions existing in another.

Sawdust into cattle food

SAWDUST has long been one of the world's largest wastes and consequently one of the greatest challenges of chemurgy. To some extent chemical treatment has been successful in converting the indigestible wood cellulose into possible foods. Two processes are already known, the Scholler process in which dilute sulphuric acid is used and the Bergius process that uses strong hydrochloric acid. By these acid treatments the cellulose is broken down into sugars. On the whole, however, sugars produced in this way have not been used for feeding but for fermentation into power alcohol.

A remarkable new development, recently reported in the United States, may lead to the large-scale and relatively inexpensive conversion of sawdust into fodder at least as digestible as meadow hay. It has been found that the exposure of sawdust to high-speed cathode rays or electron streams leads to a form of cellulose that can be digested by bacterial extracts from the cow's rumen. The resistance of the wood cellulose to digestive enzyme attack is in some unexplained way greatly reduced by irradiation with electrons. It is not known whether this occurs because the lignin in wood can no longer play some anti-bacterial and protective role or because the rays induce some small but vital change in the cellulose itself. The success of the process would seem to depend upon the amount of irradiation. Digestibility increases steadily up to a point of about 12 minutes' exposure to cathode rays;

*Intermountain Forest and Range Experiment Station Forest Service, U.S. Dept. Agriculture, Ogden, Utah. Research Paper No. 22. 1950.

after this, digestibility begins to fall, indicating that 'electronic over-cooking' has started.

At first thought, the cathode ray process may seem a somewhat costly method of producing a cattle-food of the carbohydrate value of hay. But sawdust is cheap and abundant and the process of irradiation far simpler than the older processes of saccharification with acids. It is believed that electronic conversion, operated on a large scale, would in fact be quite a cheap process. At present, however, the nutritional value of the irradiated sawdust and wood chips has only been tested in laboratory incubators. Nevertheless, there is no reason to suppose that cows themselves will not give similar verdicts to those given by extracts of the enzymes from their stomachs.

Ants, aphids and coccids

SOME time ago we had occasion to comment upon the association between ants and scale insects, with particular reference to the control of nutfall in coconut plantations in the Solomon Islands (WORLD CROPS, January 1950, **2** (1), p. 3).

A recent publication by the Commonwealth Institute of Entomology of a monograph by G. E. J. Nixon on the 'Association of Ants with Aphids and Coccids' is timely, inasmuch as it reviews existing knowledge on this important subject and dispels certain prevalent fallacies.

As Dr. W. J. Hall remarks in his introduction to the work, 'the association of ants with certain species of aphids and coccids is well known.' Moreover, an important development has been the incrimination of some of the latter as vectors of virus disease. In the circumstances it is obviously important that the role played by ants, where the insects they attend have been proved to be disease vectors, should be elucidated.

There is a vast amount of evidence on ant associations much of which is to an extent conflicting. There is, of course, no doubt that ants do attend colonies of aphids and coccids for the sake of the sweet honey dew excreted by them. Many observers have concluded that some species of ants assist the colonisation of host plants by aphids and coccids and there is evidence that has led observers to suggest that ants display a kind of foresight which causes them to carry round adults of these insects and place them on favourable feeding-ground. Many observers have recorded the presence of aphid eggs in the nests of certain species of ants during the autumn and the winter, and in the spring the ants carry the newly hatching aphids to the roots of various plants. Moreover, it is well known that many ants enclose aphids and coccids in tents, using for the purpose the type of material with which they normally construct their nests. On this the picturesque hypothesis has been built up that ants behave towards aphids and coccids as though they were cattle requiring to be milked and otherwise suitably tended.

Mr. Nixon, however, after an exhaustive examination of all the available literature, concludes that the theories advanced from time to time explaining the behaviour of ants need to be drastically modified. It is difficult to estimate the benefits gained by the ants, aphids and coccids from their mutual associations and, while certain combinations of particular species of ants with aphids and coccids may illustrate a complex and unusually intimate relationship, it is doubtful whether the term symbiosis can be used generally to describe the casual association of ants with their homopterous food sources. Moreover, there seems to be little proof, except in a few noteworthy cases, that ants play a very active part in transporting and disseminating these injurious insects, while it seems certain that the protection afforded to them by ants through driving away predators and parasites has been much exaggerated.

It is always slightly painful when long-cherished theories have to be abandoned, especially when they have a romantic appeal. Nevertheless, there can be no doubt that Mr. Nixon has performed a valuable service in marshalling and sifting the available information. Much still remains obscure and the further elucidation of this important and fascinating relationship is eminently desirable. There is no doubt that in certain well-authenticated cases particularly close and intimate relationship does exist between the two groups of insects and, if further observations can throw light on the reasons which differentiate them from the generality of cases, they may also help to clarify much that is still obscure and assist in the control of virus diseases, which are increasingly being proved to be among the most potent inimical factors with which agriculture has to contend.

Costs and prices in Britain

THE promised White Paper* describing the outcome of the 1951 review and fixing of farm prices has now been published. This is a welcome innovation and it is intended that a White Paper shall in future appear every year after the review.

As we mentioned in these columns two months ago, the price increases awarded to farmers do not nearly compensate for the increases in production costs. Now we can see, to some extent, just how the national farm's budget is to be balanced.

Since February 1950 the cost of production of agricultural and horticultural commodities has risen by £89,500,000. Price increases awarded for the livestock year 1951-52 and the crop year 1952-53 amount to £43,250,000: £32,000,000 for food products and £11,250,000 for wool. The difference of £46,250,000 has been or will be borne by the farmer,

*Annual Review and Fixing of Farm Prices, 1951. Cmd. 8239. H.M.S.O. 9d.

£10,000,000 of which is represented by a reduction of the annual £40,000,000 capital injection, which was started in 1947, to £30,000,000. It was started to provide part of the new capital required for agriculture, and took the form of additions to farm prices. The need for this is regarded by the Government as having diminished, some of the production targets having now been reached.

The remaining difference of £36,250,000 represents costs that will already have been borne in the agricultural year ended May 31, 1951, and the Government does not propose to recoup producers for this, since they consider that farmers have succeeded in bearing these costs out of their own resources while still maintaining an adequate level of income.

It will be noticed that no increase in food subsidies has been made and the 1950-51 level of £410,000,000 will be maintained. The aim is to obviate increased taxation, but it is obvious that the higher prices paid to farmers and the higher cost of imported food must inevitably be paid by the consumer.

It appears that the Government are pinning their faith to lowering of production costs, although as the White Paper says, *farmers are likely to have to work under conditions of increasing difficulty during the next year or two*. No doubt improved technical efficiency has led to substantial increases in production, which is now 40% more than it was before the war—and there is room for yet more improvement. However, in the race between increased production and rising costs, the latter seem to have the advantage, for it is hard to see how more efficient production can be achieved, if the cost of the raw materials needed to attain it are beyond the control of the farmer. The now familiar picture of prices chasing costs is no more absent from the primary industry of agriculture than it is from any other. Its effects are to be seen in one guise or another in every country and the British position is but one aspect of a worldwide problem.

May it not be that the most fruitful solution will in the end be found to lie in a policy aimed at cheapening essential raw materials rather than one of increasing subsidies for food production? This would at least stimulate efficiency and might enable farmers to negotiate lower prices for their produce, leading to a sounder and healthier economy.

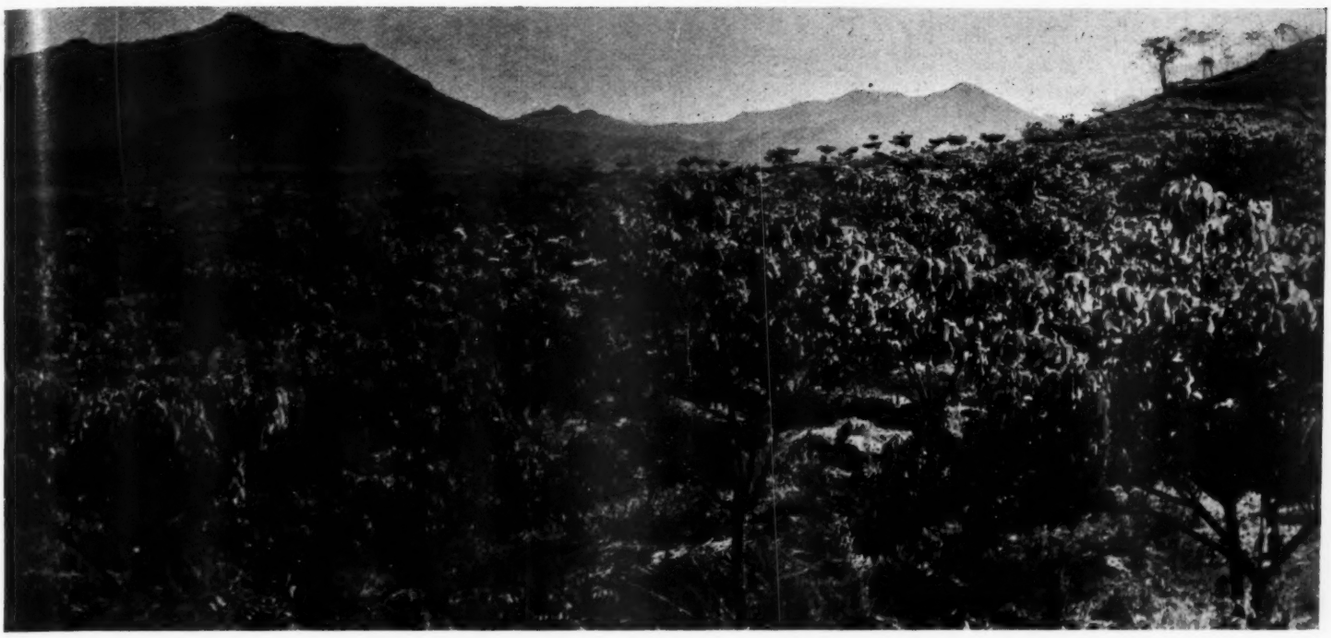
Advisory bulletins—B.C.?

LAST year's OEEC book on Europe's agricultural services (see WORLD CROPS, February 1951, 44-45) stated that 'in several European countries the origin of agricultural advisory work dates back over 100 years.' Among the recommendations made by OEEC's Working Party was a greater emphasis in all countries upon methods of advice that can enable limited staffs to reach more farmers, and one such method was the bulletin. That this is in fact an age-old method of advising farmers has recently been demonstrated by a remarkable discovery in Iraq. An archaeological exploration team from the University of Chicago and the University Museum of Philadelphia found a farmers' bulletin at Nippur. According to Dr. D. E. McCown, leader of the expedition, it is at least 3,700 years old—or *circa* 1750 B.C.! The instructions are in the Summerian language in cuneiform script on a clay tablet. They provide the 'know-how' on corn growing—how to plough, how to sow the seed 'two fingers deep,' how to deal with birds and field mice, and when to cut the crop before it bends under its own weight. Even irrigation is dealt with—a fourth irrigation will, it is said, produce a greater yield of one 'cup' of grain in every ten.

But scientific research is not given as the authority for these recommendations; nor even the experience of 'grade A' farmers! The reader is told that these detailed methods for cropping were directly provided by Ninurta, the god of the farmers. There are no doubt still many parts of the world in which an appeal to the authority of the gods would seem less mystic than scientific evidence; an article in the journal of the British Colonial Office, *Corona* (November 1950), in which an officer describes his efforts to persuade peasant farmers in Northern Nigeria to use pelleted superphosphate, shows only too clearly that the advisory problems of 20th century Africa are not very different from those of Mesopotamia in 1750 B.C. Will any remnants of our own advisory work remain to be unearthed in nearly 40 centuries' time? Perhaps by then agriculture itself will have been displaced by mass-produced and factory-synthesised proteins, fibres, and carbohydrates. Meanwhile it is perhaps salutary to learn from archaeology that agricultural advisors belong to one of the oldest professions, as old as the profession of farming itself.

THIS MONTH'S COVER

A hay baler operating on a sheep farm on the famous Canterbury Plains of New Zealand's south island. Much of the Dominion's agricultural prosperity emanates from this area, which, besides being famous for its sheep, grows most of the wheat crop. The breeding section of the Wheat Research Institute is at Lincoln Agricultural College in North Canterbury; an account of its work will appear next month.



Typical tung plantation in the Zomba district of Nyasaland, showing the mountains in the distance

The Cultivation and Production of Tung Oil

Part I

G. T. BRAY, F.R.I.C.

Colonial Products Advisory Bureau

The increasing demand for drying oils in paint and varnish manufacture has attracted attention to tung oil, which for centuries has been produced in China. It is only during comparatively recent years that its large-scale production has been embarked on in other countries, and there is now a considerable and rapidly expanding output in many parts of the world. In the first part of his article, the author discusses the sources of this product, and its production in various countries. In part II, which will appear next month, cultivation of tung trees and extraction of the oil will be dealt with.

TUNG oil or China wood oil, a high-quality drying oil mainly used in the paint and varnish industry, is obtained from the nuts of two trees, *Aleurites fordii* and *A. montana*, and up to some 20 years ago was only produced in China. Most of the tung oil exported from China is derived from the former species, while *montana* oil is rarely, if ever, shipped as such from that country, but may be mixed to the extent of about 10% with *fordii* oil. It is only in recent years that supplies of pure *montana* oil have been available for the trade. These have come mainly, if not entirely, from Nyasaland and have enabled manufacturers to test it out in comparison with *fordii* oil and to incorporate it in their products.

Tung oil was originally used in the United States and the United Kingdom for making spar varnish, in which the oil is mixed with rosin. Such varnishes have a more durable finish and better water-proofing properties than the older types made from linseed oil and a fossil gum. In latter years tung oil has found one of its largest outlets in the manufacture of specialised industrial varnishes, such as varnishes for containers, lithographic printing, insulating and aeroplanes. Other uses for tung oil are in quick-drying enamels, synthetic resins, the textile industry and wallboards.

Characteristics of tung trees

As stated above, the tung oil of commerce is derived from the two species *A. fordii* and *A. montana*. There are, however, several other species which also yield oil

but are not cultivated to any appreciable extent commercially. It is a characteristic of all species that they produce both male and female flowers which may be borne in separate inflorescences or the inflorescences may be mixed. The proportion of male to female flowers may vary considerably in individual trees, some being predominantly male while others are predominantly female. Predominantly male trees naturally produce small yields of fruit and, on this account, it is desirable that predominantly female trees should be planted. Because of this and to secure uniformity, increasing attention is being paid to vegetative methods of propagation.

Aleurites fordii

A. fordii is the more widely distributed of these two species in China and is also more hardy. It occurs in all the warm-temperate parts of that country, but more especially in those regions within the watershed of the Yangtze River, where the Chinese grow small plantations on hillsides on land which is not considered suitable for ordinary cultivation. The annual rainfall should not be less than 30 in. and the summer temperature between 90 and 110°F. The tree will stand a winter temperature of 4° of frost, but frost in the spring damages the flowers and therefore the yield of fruit suffers. Plantations in some parts of the United States have often suffered damage from this cause.

It is a quick-growing short-lived tree, seldom exceeding 30 ft. in height, with a much-branched flat-topped or rounded head and a spread of from 15 to 30 ft. The flowers are produced in clusters before the leaves unfold and are white with pink centres and yellow markings. The leaves are deciduous and, when fully grown, are dark, shining green, broadly ovate, long-pointed and heart-shaped at the base. The fruit, passing from green to dull brown when ripe, is in the shape of a flattened round, 4 to 5 cm. in diameter, with a short point at the summit, and is perfectly smooth externally. It contains from three to five broadly ovoid nuts 2 to 2.5 cm. in length and breadth, slightly ridged and warty externally. Inside the woody shell of the nuts is a cream-coloured fairly soft kernel containing about 60% of oil. The average composition of a fruit is—nut about 50% and oil 18%, and of a nut 60% kernel and 35% oil. The kernels contain some 57% oil. When fully ripe the fruits fall to the ground and eventually split into three to five segments, according to the number of nuts they contain.

A. fordii in China shows no strong preference as regards soil. It grows equally well on conglomerate, hard limestone, sandstone or sandy clay. In the United States every type of soil has been tried and the tree has been found to grow on practically any well-drained soil which is slightly acid.

Close up of the flowers on a Nyasaland tung tree; they are not unlike orange blossom

Aleurites montana

A. montana occurs in the sub-tropical parts of south-eastern China, from the Province of Chekiang southward to Tonkin in French Indo-China and also extends into the Shan States of Burma. In size, habit, foliage and general appearance it closely resembles *A. fordii*. *Montana*, however, requires a more tropical climate with a higher temperature and rainfall. The soil requirements are similar to those of *fordii*. The fruits are markedly distinct, being egg-shaped, 5 to 6 cm. long and 4 to 4.5 cm. broad, with longitudinal and transverse raised ridges. They each usually contain only three nuts, each 3 cm. long and 2.5 cm. broad, warty on the outside. The husk of the fruit is thicker and more woody than that of the other species. The woody shell of the nut contains a fairly soft kernel which contains as much oil as that of *fordii*. The average composition of a fruit is 42% nut and 14% oil, and that of a nut 58% kernel and 31% oil.

Other species

Aleurites moluccana, the candlenut tree, is a native of the South Pacific. It is a large evergreen tree, yielding an oil with drying properties somewhat inferior to linseed oil. *A. trisperma* is another species which is said to produce an oil suitable for paint and varnish manufacture but inferior to tung oil. The remaining species is *A. cordata*, found in Japan and known as the Japanese wood oil tree.

Production of tung oil

Up to the early years of the 20th century China was the only country producing commercial supplies of tung oil. Because of this dependence on a single country for their requirements, trials have been undertaken in the United States, the British Commonwealth and elsewhere to ascertain whether these two species of *Aleurites* can be profitably cultivated in these countries.

China

The cultivation of tung trees is spread over some 900,000 sq. miles of China, mainly in the provinces of Szechwan, Hunan, Hupeh, Kwangsi and Chekiang. *Fordii* is found particularly in the Yangtze valley and *montana* in south China. In 1948 the production of tung oil in China was 113,000 tons, of which 75,000 tons were exported, while in 1949 the production was 98,200 tons, of which about 50,000 tons were exported, the United States taking 21,500 tons and the United Kingdom 9,700 tons. Hong Kong is the main port of shipment.

United States

The first experimental distribution of *A. fordii* seed was made by the United

Nuts of the tung tree after the flowers have bloomed. At this stage they are the same size and colour as walnuts

States Department of Agriculture in 1905. These trials proved so successful that the American Tung Oil Corporation was formed in 1923 as a co-operative effort among members of the American Paint and Varnish Manufacturers' Association. The area under tung in the U.S.A. in 1949 was estimated to be about 250,000 acres with an annual production of 8,700 tons of oil. A greater area than this has been planted, but a considerable number of acres have been abandoned, as they were found to be unsuitable for the crop. The domestic production is not yet large enough to satisfy American demand and supplies still have to be imported from China and elsewhere. The main plantations have been established in the southern states, particularly in Mississippi, Florida, Louisiana, Alabama, Georgia and Texas. Only *fordii* is grown, the climate being insufficiently tropical for *montana*. Even so, the climate in these states is not all that might be desired, as the trees in some years are adversely affected in early spring by frosts which kill the flowers and thereby reduce the yield of the fruit.

British Commonwealth

As far back as 1917 the Imperial Institute instigated experimental cultivation trials with *A. fordii* in a few countries of the Commonwealth, but the results were inconclusive and failed to supply much evidence as to localities suitable for the cultivation of these trees. During the years 1928 to 1933, the Director of the Paint Research Station of the British Paint, Colour and Varnish Manufacturers' Association, the Director of the Royal Botanic Gardens, Kew, and the Imperial Institute Sub-Committee on Tung Oil, acting in collaboration, caused supplies of seed not only of *fordii* but also of *montana* to be sent to many parts of the Commonwealth where climatic and other conditions seemed favourable. Many of these trials were made possible by a grant from the former Empire Marketing Board, while in some countries additional trials were made by private enterprise. The results of these trials were very varied and in many cases disappointing, but in a few countries they showed that tung trees would thrive and, in consequence, the production of tung oil on a commercial scale was started in Nyasaland, South Africa, Australia and Burma. The last-named country is no longer a member of the British Commonwealth, but it may be mentioned that the four companies which were operating there in 1939 have now ceased to do so; in some cases the plantations were destroyed or severely damaged through neglect during the Japanse occupation. Nyasaland is now the most important country of the Commonwealth which is growing tung trees. Originally the plantations were of *fordii*, but of later years *montana*, which thrives better there, has become more popular and is the species now being planted. The industry has developed quite rapidly. A Tung Growers' Association was formed in 1938. Late in 1940 a Tung Experiment Station was opened at Chisawanu, Cholo, for which purpose a grant was made by the Colonial Development and Welfare Fund, while in 1942 a factory was brought into operation to express the oil from the locally grown fruit.

The area under tung in 1948 was 16,000 acres and the production was 705 tons of nuts, consisting of 74 tons of *fordii* and 631 tons of *montana*. The oil produced in that year was 216 tons, while in 1949, 287 tons of oil were exported.

Most of the plantations are situated in the districts of Cholo, Mlanje, Blantyre and Zomba. Recently, however, under the auspices of the Colonial Development Corporation, plans have been drawn up and a start made with establishing plantations in the northern part of Nyasaland on the Vipya plateau. The suitability of this district for tung plantations was investigated in 1946 by the Department of Agriculture, Nyasaland, and, as a result, selected areas were taken over by the Colonial Development Corporation in 1949 with the object of developing 20,000 acres in four units of approximately equal size within ten years. It is planned to have 1,000 acres under cultivation by 1952, and after 1953 it is hoped to plant 3,000 acres per annum; the scheme is expected to have been completed by 1958, and by 1961 1,780 acres should be in full production; the whole plantation should be in full production by 1967, when a yield of 5,020 tons of oil per annum should be obtained. The work already completed comprises land clearing, road making, erection of living quarters and the construction of jetties on Lake Nyasa. Ultimately, three crushing plants are to be erected.

Union of South Africa

By 1939, tung production in the Union of South Africa had expanded so much that the South African Tung Growers' Association was formed. It is estimated that in 1949 there were 200,000 trees in South Africa and 175,000 in Swaziland. Research on tung cultivation is undertaken at the Sub-Tropical Horticultural Research Station at Nelspruit, Transvaal. The nuts are processed by two companies. *Fordii* has up till recently been generally grown, but *montana* is now coming into favour.

Australia and India

In Queensland about 1,000 acres are under *fordii*, containing some 150,000 trees, the nuts are processed by Tung Oil Mills Ltd. at Sydney, New South Wales, where there is also a small production of nuts. In India there is a small production

of tung oil, mostly *montana*. The trees are grown mainly on tea plantations in Assam and north Bengal. Practically the whole output of nuts is crushed at Naihati, Bengal.

Other Asiatic countries

Montana occurs naturally in Indo-China, particularly in eastern Tonkin and northern Annam. The trees are spread over a fairly wide area and the exact acreage is not known. In 1947 some 80 tons of oil were produced. In Java some 2,000 acres have been planted, mostly under *montana*.

South America

Tung oil production has advanced in certain South American countries in spectacular fashion recently, and it bids fair to become one of the main producing regions. In Argentina a National Tung Commission has been formed and the large-scale planting of *fordii* trees was started in 1939. By 1947, 107,000 acres were under this crop, containing 10,500,000 trees. In 1950 the acreage had risen to 112,000, the production of nuts being estimated at 40,200 tons and of oil 6,200 tons. In 1949, 8,100 tons of oil were exported, mainly to the United States. Nearly all the tung trees in Argentina are in Misiones, where there are three experiment stations and four factories with a capacity of 6,800 tons of seed. It is considered that these factories, unless they are enlarged or increased in number, will be insufficient to deal with the anticipated enhanced production of fruit.

Brazil also has some 4,000,000 *fordii* trees, more than half of which are at Parana. The oil is expelled in the local factories. The production of nuts was estimated at 7,000 tons and of oil 300 tons in 1948.

In Paraguay tung cultivation is carried on mostly in the Encarnacion area, near the Parana River. In 1949, 1,200 tons of oil were produced and it is estimated that in 1950 6,500 tons of nuts giving 1,620 tons of oil were obtained.

Africa

In the Belgian Congo commercial plantations were started in 1938, and by 1947 some 3,000 acres had been planted with *montana*, chiefly in the Stanleyville Province. Trials with *fordii* were not successful. Madagascar has about 1,000,000 trees, mostly *montana*, near Itasy Lake at Antscrabe and Fianarantsoa, although *fordii* has proved successful in the High Plateau. The acreage is about 6,000 and the export of oil 300 tons in 1950. A smaller acreage (2,500) is under *montana* in the French Cameroons.

Russia

In the U.S.S.R. the first commercial plantation of *fordii* was established at Batum in 1929. Cultivation was greatly extended under the second five-year plan and, by 1950, 55,000 acres were reported to be under tung, the chief areas lying along the Black Sea coast. In spite of unfavourable ecological conditions, *fordii* has been successfully acclimatised and high yields of oil of good quality, stated to have been as high as ¾ to 1 ton of oil per acre, have been obtained.

Besides the countries mentioned above, very small acreages and experimental plantations have been established elsewhere. From the foregoing it will be seen how rapidly the production of tung oil is increasing in many parts of the world.

Photos: Public Relations Office, Zomba, Nyasaland

(*To be concluded next month*)

Irrigation and Settlement Project in Pakistan's Thal Area

THE Thal* project in the north-west Punjab is a major item in Pakistan's development programme to increase the cultivated area with the object of increasing food production to keep pace with the growth of the population.

Agriculture is by far the most important industry in Pakistan, and the one from which 90% of the population derives its livelihood. At present it provides sufficient food for the whole population and a small surplus for export. It also provides, in the shape of jute and cotton, the principal cash crops which Pakistan exports and on which its new industries are based.

The Thal project

The Thal project is a Provincial Government scheme under which the Punjab Government envisages the irrigation and colonisation of 5,000,000 acres of waste land. It is planned to bring perennial irrigation to about 2,000,000 acres, and later bring non-perennial irrigation to 3,000,000 acres. Schemes for colonisation, which are already under way, are designed to bring into the area 250,000 settlers to be placed on small farms. Roads are being constructed and 900 new villages, provided with medical and education facilities and social amenities, are being built; 100 of these are already completed. The villages are being linked by a network of macadamised roads to new townships now under construction to provide for the marketing of agricultural produce. A number of workshops and sawmills have been started in these new townships, and it is expected that cotton-spinning factories will also be established. Production of wool has already become a staple industry in the region and grazing grounds for sheep are being provided for each village.

Colombo plan assistance

It was announced in March that the Australian Government had made arrangements to send to Pakistan a team of agricultural and scientific experts to advise on the Thal development project. This offer was made under the technical co-operation scheme of the Colombo Plan.

The plans for the development of the Thal envisage the following increased production from the irrigated area: wheat, 190,000 tons; cotton, 20,000 tons; gram (a chick-pea used for food), 60,000 tons; oilseeds, 20,000 tons; and sugar cane, 50,000 tons. The value of the increased agricultural production is estimated at 87,700,000 rupees per annum. The total area brought under irrigated cultivation in 1949-50, the first year of operation, was 146,661 acres.

Chaudhri Nazir Ahmed Khan, Pakistan Minister for Industries, who visited the Thal region in January to study the prospects of industrialisation, said that several industries would be established there, including a fertiliser plant at Daudkhel, a cement factory in the salt range (near Kalabagh), a sugar mill at Khushab, a cotton textile mill at Gunjyal (now Quaidabad), and a woollen textile mill at Darya Khan.

Development of power resources

The Minister also stated that generation of power was given high priority in the Thal scheme. The Mianwali hydro-electric scheme, which would have an installed capacity of 90,000 kw., had, he said, passed through the planning stage and its execution was under active consideration. The power generated would be sufficient to meet the requirements of the industries to be set up in the Thal.

The development of power resources is an essential feature of both agricultural and industrial development plans in Pakistan. The power resources of the country were explored in 1948 by Sir Henry Howard, a British consulting engineer, and a report was submitted to the Pakistan Government. The Government subsequently appointed as their advisers on hydro-electric development two United Kingdom firms of consulting engineers, who are preparing a scheme for power development.

* The area known as the Thal is between the Jhelum and Indus Rivers in the Western Punjab.

(*Left*) **The outfall end of an internal drainage system with pump houses for lifting its water into the river behind.** (*Right*) **A main internal drain passing from one fen to another via a culvert under the embanked high-level river (forming the skyline in the picture)**

Groundwater Control in Reclaimed Marshland

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School of Agriculture, Cambridge University

With increasing populations and consequent growing demands for greater production, the possibility of bringing new areas into cultivation is all-important. The reclamation of some of the vast areas of marshy land found in all parts of the world, many of which are potentially highly fertile once surplus water can be removed, is one of the ways of doing this. The subject is discussed in this paper, mainly in the light of experience gained in the English Fenlands. Much of the latter is, however, of general application and of direct interest to those concerned with reclamation problems in all parts of the world.

THE natural development of river systems as we find them today has usually been accompanied by the deposition of broad alluvial expanses alongside the main streams and especially towards their mouths. These mainly consist of fine silt, rich in mineral nutrients, and are the result of erosion in the higher parts of the catchment area. Moreover, the meanderings of a river amidst its alluvial deposits have, in many cases, produced swamp conditions locally in which a luxuriant growth of vegetation has led to extensive accumulations of peat.

Reclamation by drainage

Hence the world over we find considerable areas of land, potentially or actually of high fertility, in which the most important factor is the ground water and its level. Much of Holland, of the Fen district of England, of the Vistula Delta and many other localities are examples of productive agricultural regions brought into use as the result of imposing a measure of control on their original ground water. Large-scale drainage works for the removal of the surplus are the first step and the process of reclamation is complicated and continuous. Such areas must be protected from the influx of surplus water from the surrounding highlands whether it enters by seepage or by the overflowing of the rivers which pass through them. Accordingly the alluvial flats are enclosed by a protective catchwater drain round the perimeter, the traversing rivers and their tributaries are contained within levees, and within the protected enclosures artificial channels are cut and developed as an internal drainage system to provide for the evacuation of the area's own surplus water into the rivers either by gravity flow or, where necessary, by pumping.

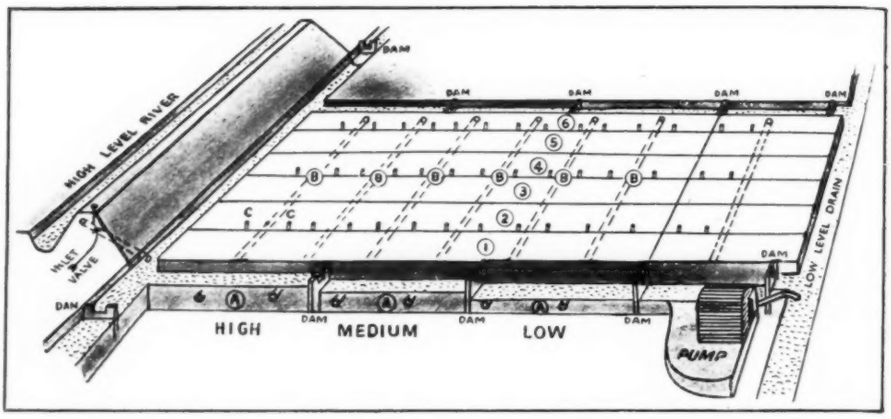
Effects of drainage

By such means the general level of the water within the area is lowered sufficiently to provide a drained soil which can be brought into cultivation. Where the reclaimed land consists mainly of mineral deposits, such as sand or silt, its continued utilisation depends on normal agricultural treatment. Its drainage system continues to function steadily and produces few difficulties and problems. In the case of reclaimed peat areas, on the other hand, right from the start the initial drainage measures produce effects which have not always been foreseen and which necessitate

enhanced efforts and a continual struggle to enable the drainage system and the control of ground water level to continue to function.

Peat wastage

The difficulties are due to the nature of peat which occurs as an accumulation of organic material above the solid mineral surface of the land. Its level rises as the material accumulates, so that the streams meandering through it function at that surface level under natural conditions. So soon as an arterial drainage system is established, however, the peat deposit begins to lose much of its water, consequent on the easier emptying of the channels. Waterlogged peat consists mainly of water, which actually constitutes 80% of its volume; the solid matter is predominantly, if not wholly, organic and, though it is evenly disseminated through the total volume of the deposit, it occupies only a very small proportion of it. Consequently, when the mean water level is lowered, the peat deposit is substantially ' deflated,' and considerable shrinkage occurs. Moreover, cultivation inevitably imposes on the reclaimed lands much more effective aeration and oxidation, thereby entailing the disappearance of some of the organic matter of the peat, and this loss is added to, and accelerates, shrinkage occasioned by drainage.



An installation for a field experiment on controlled ground water levels

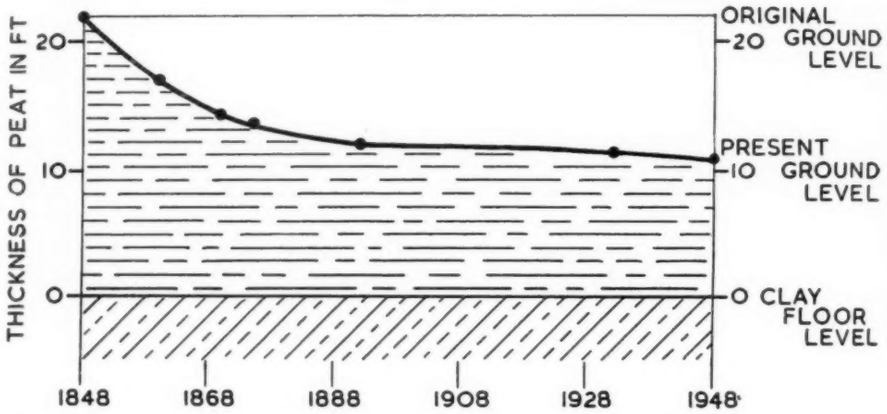


Diagram shows the course of the shrinkage of peat during 100 years after drainage, at Holme post

Subsidence

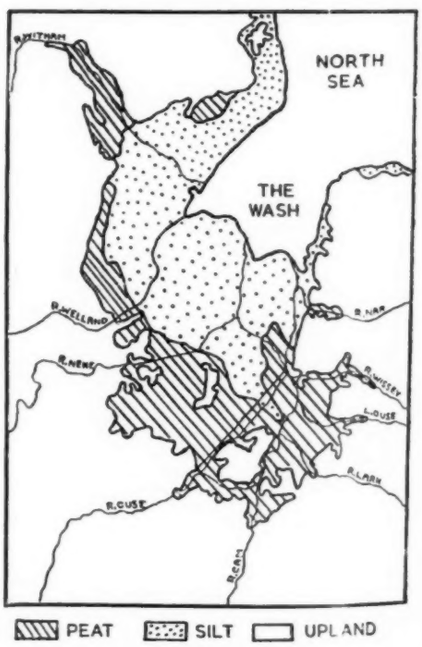
It is common experience that the reclamation of peat by draining causes the surface of the land to subside by as much as a foot in the first year. Moreover, this shrinkage continues, though at a reduced rate, in subsequent years despite measures to mitigate it. Its extent can be gauged by the records of an iron post driven through a peat deposit into the underlying solid earth near Holme in England in 1848 during the early stages of the reclamation of a fen by drainage; it was driven in until its top was level with the surrounding peat. The extent of the shrinkage of the peat which has occurred is indicated by the fact that today, after 103 years, 11 ft. 5 in. of the post are exposed above ground level.

Drainage troubles

For this reason it is usually not long before the drainage system in a reclaimed peat area is in difficulties, due to the land surface sinking below the level of the rivers, thereby putting an end to gravity run-off from the drained area itself, while the streams which carry the drainage through such regions can only continue to function if their banks are kept at the original level by the provision of levees. This necessitates the isolation of the internal drainage from the stream, so that it can be kept in being by deepening its main channels as the shrinkage continues and giving them sufficient fall to carry their water to a suitable point on the main river, where there is an adequate pump to lift the water over the intervening levee. Further, as the years pass and shrinkage continues, the extent and effort of the lift increases, so that more power is required to accomplish it.

English Fens

Some of the long-term aspects of these changes are illustrated by the characteristics of the English Fenland country which surrounds the Wash, a bay of the North Sea. The Fenlands occupy some 1,300 square miles, of which a belt up to 17 miles broad, adjacent to the sea coast, is occupied by silt land, which is not subject to shrinkage on draining, and the surface of which is about 10 ft. above sea level. Inland and behind the silt belt lies an irregular expanse of peat land, amounting to about half the total Fen area. Originally the surface of this peat area was some 5 ft. or so higher than that of the silt land nearer to the sea; today, however, as the result of reclamation drainage, its surface is at or below sea level and accordingly it is not surprising to find that the main



The English Fen country

rivers and their tributaries within the drained area are confined within flood-banks standing 11 to 14 ft. above sea level, while the actual water surface of these rivers in summer stands at about 6 ft. above sea level. The internal drainage systems of much of the peat lands, on the other hand, are working at levels from 2 to 6 ft. below sea level and the water has to be lifted some 10 ft. or so into the rivers by pumps.

It will be seen that the effort required to keep the reclaimed land above water steadily increases with lapse of time; the surplus percolation of the wet season has to be pumped out from steadily increasing depths, the danger of flooding by the embanked river also increases and calls for more and more expensive works to counter it, while in the dry season there often arises a cry from farmers for more water just when the rivers are least able to supply it.

Water requirements of crops

It must be remembered that in the wet season rainfall exceeds evaporation and transpiration, but at other times, and especially in the growing season, the reverse is the case and the ground water level as a result may fall so far and so fast that the roots of crops, especially those planted late, may have difficulty in developing their root systems sufficiently to get all the moisture they need. Hence arises speculation as to the optimum ground water level and a desire to manipulate it for the good of a particular farming system. The tacit assumption is that the ground water can make a substantial contribution to satisfy the moisture requirements of the crops.

Soil moisture

Ordinarily the growing plant develops a root system which searches the soil for water from the surface downwards. It can absorb all that the soil holds between the stage at which it is just drained and that at which it retains a residue with forces greater than those which the root can exert to assimilate it, *i.e.* the wilting point. The soil can supply much of a plant's water requirements so long as the plant can develop its root system continuously downwards into regions which still hold assimilable moisture. This it can continue to do until further growth is checked by the ground water table, but before that happens it has occupied the so-called capillary zone which is kept supplied with moisture from the ground water. The effective limits of this capillary rise are of the order of 20 to 24 in. In the absence of ground water the plant is dependent wholly on the soil moisture and on any rain which may happen to fall during the growing season and remoisten the soil from the surface downwards. Such replenishments are, however, intermittent and variable in amount.

The post in Holme Fen, Hunts, England, as it appeared in March 1951

Importance of rain

Determinations of the transpiration ratios for crop plants grown in England suggest that a cereal crop requires the equivalent of some 6 to 8 in. of rain for its development. Some soils can contain as much as this, even when drainage has ceased, within the top foot; only a fraction of this is, however, available to the growing plant, and on this account the available moisture of 2 or 3 ft. of soil is necessary directly to supply from the soil alone all the water required. The value of a nicely distributed incidence of rain during the season of active growth is consequently easily appreciated. In the Fen country of England, from April to September inclusive, the rainfall has varied in recent years between 6 and 16 in. With the former level of incidence the supplement which it provides to the soil reserves of moisture is certainly impressive when set against the amount which a crop transpires, but considered in conjunction with its frequently irregular distribution over the growing period it is often insufficient to maintain vigorous growth, and particularly so if planting coincides with a dry spell.

Life history of crops

This emphasises the importance of relating the life history of specific crops and their developmental stages to the seasonal fluctuations of rainfall and soil moistures, especially as regards the vertical distribution of the latter in the soil and its relation to the ground water level. The point will be well appreciated when one contrasts conditions for autumn-sown cereals with those, for instance, for celery. The former start life when the surface soil moisture content is increasing and adequate. Their initial development takes place against a steadily rising ground water level in conditions of falling temperature. The advantages of adequate drainage to keep the water table down then are very real. The active growth period coincides with the warming up of the soil and its seasonal drying from the surface downwards, but by this time the root development may be, as it were, ahead of the drying out and closely following the falling water table. Comparatively speaking, this crop is independent of deficiencies in the summer rainfall.

The case of celery is different. This crop needs a good supply of moisture for its steady growth, but is planted out after the onset of drying conditions. Its root system is shallow and the crop is accordingly markedly dependent on judicious cultivation aimed at maintaining the maximum moisture content in the topsoil at the time of planting. A low or falling ground water level may be out of reach of the young plant and the importance of the incidence of summer rainfall is therefore very great. Where conditions allow, the ground water level can be successfully controlled to benefit the crop and some celery growers get highly satisfactory results by keeping the water table high or by raising it for the duration of the growing season. Others do equally well by keeping it very low and relying on skilful cultivations to keep the soil moisture conditions right without the help of the ground water.

Peat and silt soils

These contrasting methods are, of course, associated with wide differences in the nature of the soils in which they are employed. The former practice is associated with peat soils, which may be as little as 2 ft. or as much as 10 ft. in depth, lying on a mineral floor which is generally clay and therefore impermeable; the latter prevails on mineral alluvial soils—silts of varying degrees of heaviness—the difference can be accounted for in terms of their respective porosity and ease of drainage. In general, peat soils are much more porous than are silts, so that they are more easily drained, while, conversely, the ground water level is

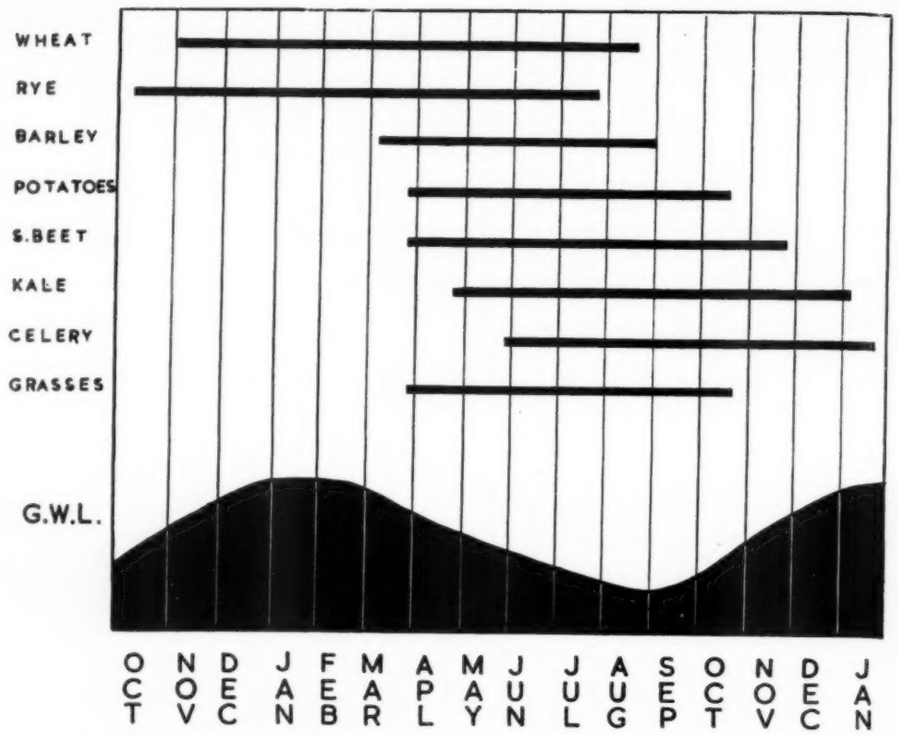
more easily raised or kept steady in them. The influence of the ditch water level on the water table in midfield is also more pronounced and by manipulating the former the latter can be closely controlled in practice, especially if the ditches are supplemented by underground pipelines or ordinary agricultural drain pipes laid from ditch to ditch. In the silt areas, on the other hand, field drains are much more in evidence than in the peats, but their primary function is the ordinary one of evacuating the winter surplus of ground water rather than its control by sub-irrigation in the summer.

Ground water

Obviously the control of ground water involves consideration of the type of soil—especially its profile aspect in terms of porosity and the ease of movement of water within it—its depth and the nature of the substratum. This last decisively influences the dimensions of the body of ground water concerned. If the substratum is clay, the ground water is perched on it, and in the case of peat is confined to the few feet immediately below the soil surface. As its level falls in a dry season replenishment can only come from the rivers via the internal drainage channels. But when the soil lies on a porous stratum this, too, is water-bearing material and the ground water may be of considerable depth. In such circumstances replenishment can come from below by the steady equalisation of hydrostatic pressure over a wide area.

The significance of this can be illustrated by a comparison of Dutch and English Fen conditions. In alluvial Holland about 25% of the area is occupied by water—ditches, drains, canals, rivers and lakes. In the English Fen country, on the other hand, the area so occupied is by contrast very small, a mere 2 to 3%. In Holland, too, the substratum is mainly porous water-bearing material to considerable depths, whereas in England the alluvium is thin and lies mostly on impervious clay formations. The result is that in summer the Dutch, owing to the circumstances and their system of control, succeed in maintaining a generally high ground water level. In England, on the other hand, the majority of summers are characterised by a substantial lowering of the ground water level; on occasion it may totally disappear, while very little water remains in the main drains and rivers.

Visitors to Holland, especially those from England, are frequently struck by the level appearance of the crops in individual fields. This is to be attributed to the striking uniformity achieved in each field by close control of the ground water level and by careful levelling of the soil surface. In peat areas especially irregularities of the underlying mineral floor, and so of the thickness of the overlying peat, coupled with shrinkage effects, can produce unevenness in the surface level, which within individual fields may amount to as much as 2 to 3 ft.; on this account levelling of the ground is an essential accompaniment of ground water level control.



The growing period of a selection of crops relative to the seasonal rise and fall of uncontrolled ground water levels in English conditions

Secondary effects

The consequences of sub-irrigation and raising the ground water level may not all be desirable, and some of these should be mentioned. Thus, the nearer the water level comes to the surface of the soil the more likely is a heavy fall of rain to water-log the soil completely; such a condition may persist in the absence of an adequate drainage system even in summer, for long enough to check the crop to a serious extent. An inch of rain can raise the ground water level 10 to 12 in. and the higher it is the smaller will be the amount of soil from which the plant can draw nutrients. Moreover, enhanced growth due to abundance of water may, and probably will, lead to exhaustion of the soil unless adequate manuring is part of the system of management. For many crops also cultivation operations may be severely handicapped by a high water table, the use of heavy machinery may become impossible, while hand operations are rendered more laborious and less effective; in addition, weeds tend to become more aggressive and their control more difficult. The general health of the crop may also be affected, and the possible effect of a high water table on the incidence of pests and diseases needs to be kept in mind, as does also possible influence on the quality of the produce. Finally, there may be important secondary effects on the soil itself of a high water table, according to whether the net movement of water through the body of the soil is upwards or downwards; in the former harmful accumulations of salts in the surface layer can appear after some time.

Conclusion

In the foregoing pages the attempt has been made to outline the principles involved in reclamation of swampy lands by drainage and some of the more important difficulties and problems which can arise and must be solved if reclamation is to be permanently and continuously successful. It is true that the information given mainly relates to the aspects presented in the Fen country in England. Nevertheless, many of the points are of general application and, making due allowance for altered conditions, will apply with due modifications to reclamation in other parts of the world.

Diagram: top p. 252, Farmers Weekly, London

Agricultural Research in New Zealand

Part I The Cawthron Institute

Agricultural research in New Zealand has made great advances during the past 30 years, and in addition to the many activities of its Department of Scientific and Industrial Research and Department of Agriculture, there are a number of institutions devoted to various aspects of agricultural research. Below is an account of the work of the Cawthron Institute, based on annual reports and information supplied by the New Zealand Government Authorities. Next month an account of the N.Z. Wheat Research Institute will be given.

THE Cawthron Institute was established in 1920 as the result of a munificent bequest by the late Thomas Cawthron. Mr. Cawthron bequeathed practically the whole of his estate, valued at £240,000, for the establishment of a technical institute and museum. The original Trustees appointed under the will of Thomas Cawthron recommended, on the advice of an advisory committee, that the main function of the Institute should be the conduct of research work in the interests of New Zealand agriculture with reference to problems of both farmers and orchardists.

The recommendations of the Trustees were approved by the Supreme Court, and early in 1920, the nucleus staff under the Directorship of the late Sir Thomas H. Easterfield was appointed and work commenced.

Three main departments of scientific research were established in 1920, and these have been maintained with but little change until the close of 1941, when a biochemical department was established to handle more effectively plant and animal nutritional problems. The principal work of the four scientific departments is connected with (a) soil and general agricultural problems, (b) plant chemistry and mineral deficiency problems of stock, (c) insect problems of farm, orchard and timber, and the biological control of noxious weeds and (d) fungus disease problems of fruit, hops, tobacco and market garden crops. A technical museum having special reference to the primary industries of Nelson and the natural history section of museum work forms an integral part of the Institute, and has been developed in so far as available accommodation permitted.

During the period that has elapsed since the inception of the Institute several additional bequests have been received. Among these may be mentioned the valuable bequest of the late James W. Marsden, who gave 65 acres of land and one-fourth share in the residue of his estate for the conduct of investigations relating to agriculture and forestry; the bequest of the late Isaac Hopkins for the investigation of honey problems; the bequests of the late Alfred Philpott and Arthur R. Atkinson, and the more recent bequests of the late John George Bartel, George Graham and Sarah Ann White.

The work of the Institute has been assisted from time to time by grants from the Empire Marketing Board, the Department of Scientific and Industrial Research, the primary producers of New Zealand and local bodies in different parts of the country. These donations have been of great assistance in expanding the work of the Institute. In recent years increased financial assistance has been given by the Minister of Scientific and Industrial Research, which has enabled the scope of the work to be maintained despite a marked fall in interest rates.

The work of the Institute is now well-known throughout New Zealand and the scientific world, and has won many favourable comments from both primary producers and scientists.

The present Director of the Institute is Sir Theodore Rigg, and the scientific graduate staff numbers over 20 with additional appropriate provision of junior staff. Associated with the Institute is the Entomological Research Station, operated as a joint undertaking with the New Zealand Department of Scientific and Industrial Research, whose Director, Dr. D. Miller, is also Assistant Director of the Institute itself. Among the many contributions to the solution of agricultural problems in New Zealand the following may be regarded as outstanding.

The Cawthron Institute, Nelson, South Island, New Zealand

Cobalt and bush sickness

At one time this malady caused considerable losses of livestock. Research by workers at Cawthron narrowed the cause down to mineral deficiency. Parallel work on similar maladies in Australia had indicated the importance of cobalt in animal and plant nutrition; trials at Cawthron subsequently demonstrated that administration of small amounts of cobalt in drench form proved an effective cure for bush sickness. This paved the way for further work, an analytical technique was developed for estimating very small amounts of cobalt, and as a result of numerous determinations of the cobalt content of soils, pasture plants and the organs of farm animals it emerged conclusively that bush sickness was the result of cobalt deficiency.

Soil surveys

The Institute has played an important part in soil survey work in cooperation with the Soils Bureau of the New Zealand Department of Scientific and Industrial Research, as an essential preliminary for formulating sound proposals for land utilisation. A reconnaissance survey of the tobacco soils in Collingwood county has been completed, and the reclassification of soils in Waimea and Takaka counties commenced. In the Moutere Hills of Waimea county there has been much soil deterioration owing to erosion, and rehabilitation. The field work has shown that these soils require subdivision into several distinct types owing to different degrees of leaching and the influence of cyclic salt. Experience has shown that *Pinus insignis* does well there and it is certain that the rougher and more impoverished areas are best utilised for forestry and timber production under this species.

Arrangements have now been completed for the conduct, in cooperation with the Departments of Agriculture and Lands and Surveys, of land use and land classification surveys over the whole Moutere formation which embraces some 285,000 acres.

Trade elements

Apart from cobalt, work on trace elements has for some time formed an important part of the Institute's activities. Boron deficiencies in raspberries is a case in point, and it has now been confirmed that 'die back' in this crop is due to this cause. Work has also been carried out to investigate the possible effects of copper, zinc and manganese on apples and other fruit trees.

Manurial experiments with fruit trees and other crops are carried out by the Institute. Of particular interest are some results recently obtained from examination of the mineral and nitrogen status of apple leaves from certain fertiliser trials, of which the following account is taken from the Annual Report of the Institute for the year 1949-50.

Samples of leaves collected from the Sturmer, Jonathan and Cox's experimental plots in two different seasons have been analysed. Considerable differences in the percentages of minerals and nitrogen occur in the analyses of leaves from the same trees in the two seasons, due to differences in date of sampling and this makes it desirable to analyse a further set of leaf samples before summarising the analytical data. The results, however, are in keeping with the fertiliser history of the experimental plots and show well-marked reductions in phosphorus, potassium and nitrogen where these elements have been omitted from the treatments, e.g. Sturmer (untreated) gave 0.43% P_2O_5 in the leaves compared with 0.76% P_2O_5 for the plot receiving superphosphate only. Similarly the nitrogen contents of leaves were 1.56% nitrogen (untreated) compared with 1.92% for the plot receiving sulphate of ammonia only.

Similar analytical work has been carried out for three seasons on the leaves of Dougherty trees manured in different ways at the Annesbrook Orchard. Pronounced differences in potassium and nitrogen levels of the leaves resulted from the omission of these elements from fertilisers used in the manurial treatments. The effect of phosphate omission on the phosphorus status of the leaves was not so marked as that quoted for Sturmer leaves at the Appleby Research Orchard.

Influence of apple stocks on yield

Other interesting results have been obtained from experiments to test the effect of stocks on apple yields. These have been in progress for the past 15 to 18 years and are accordingly of considerable weight. It has been found that Double Vigour (French Crab vegetatively propagated from the Statesman variety of apple) show to advantage over Northern Spy stock. The Statesman trees are now in their 18th year from planting. Yields with the two stocks over the past five years are shown below.

Pounds of Fruit per Tree

Year	*Northern spy stock*	*Double vigour stock*
1945	141	181
1946	228	268
1947	167	210
1948	132	189
1949	43	54
Total for five years ..	711	902

Tests with a vegetatively propagated stock derived from Epp's seedling has given much greater growth with Cox's Orange and Jonathan varieties than is the case on Northern Spy stock.

Yield of fruit is better in the case of the Jonathan variety on the more vigorous stock. In the case of Cox's Orange variety, the yield of fruit on the two stocks is about the same. The trees are now 15 years old. The fruit yields for both varieties on the two stocks are shown in the table below.

Crop disease investigations

The Institute has carried out numerous investigations on problems of diseases affecting crops. Among the matters recently examined have been the following:

Diseases of hops. Hop growing is a not unimportant industry in New Zealand and a survey of 48 commercial gardens in the Nelson district has shown that Black Root-rot (*Phytophthora sp.*) is the most common disease. The intensity varies on different soils, the Wakefield-Waiti locality being relatively free from the trouble. Field experiments for the control of the disease have been extended and tests with calcium cyanide have been included in the soil treatments in addition to chloropicrin and D-D soil disinfectants. A survey of the fertility status of hop soils in the Nelson district has shown that many gardens have a very low content of available potash. The lime status showed great variation in different gardens.

Tobacco. Work has been carried out in co-operation with the Tobacco Research Station on many problems associated with the flue-cured tobacco industry. Investiga-

Pounds of Fruit per Tree

Year	*Cox's Orange*		*Jonathan*	
	Northern spy stock	*Epps' seedling stock*	*Northern spy stock*	*Epps' seedling stock*
1945	62	33	95	105
1946	138	185	169	200
1947	86	60	103	91
1948	113	144	187	255
1949	72	69	90	132
Total for 5 years	471	491	644	783

Spraying fruit trees in the Nelson district, New Zealand, according to directions issued by the Cawthron Institute, has resulted in healthier crops

tions have included disease surveys for Mosaic, Black Root-Rot, Verticillium Wilt and Angular Leaf Spot. The susceptibility of weeds and cover crops to both Black Root-rot and Verticillium Wilt has been determined and tests for the control of these diseases have been carried out with a number of chemicals. Chemical investigations relating to tobacco have included studies of nitrogen, sugar and mineral status under different fertiliser and cultural practices.

Tomatoes. Investigations have been performed on tomato problems. Tests of steam, chloropicrin, D-D and Sterizal have been made on both glasshouse and outside garden soil. The beneficial effect of heavy potassic dressings in the improvement of quality of tomatoes in both glasshouses and outside tomato culture at Nelson has been confirmed. A study of the intake of plant nutrients in glasshouse tomatoes has shown the very large amounts of nitrogen and potassium which are required for the maintenance of high yield and quality of the crop.

Entomological research

The staff of the Entomological Research Station have investigated a great variety of problems not only in Nelson but in other parts of New Zealand. Perhaps the most important of the entomological investigations have been those relating to the control of the N.Z. grass-grub and grass-caterpillar. Some 15 consignments of parasites for the control of grass-grub were obtained from Australia and liberated on infested land in Nelson and at Ashburton. A few parasite individuals have been recovered from the field indicating that the parasites have completed one generation on the grass-grub.

Tests with soil insecticides have been carried out against grass-grubs. Of the chemicals tested chlordane appears to be the most promising as regards efficiency and cost. Gammexane, incorporated with superphosphate, has given good results in control of grass-caterpillar and this method of control appears to have considerable advantages over the use of poisoned bran baits.

Advisory work and other activities

The Institute maintains a fully-equipped meteorological station and is one of the official recording stations of New Zealand, daily records being taken of air and soil temperatures, barometric pressure and rainfall.

It undertakes a considerable amount of advisory work relating to identification of insect pests and fungoid diseases and other farming problems including those of soils and fertilisers. Regular visits are paid to the Institute by groups of farmers and others interested, while periodical conferences are arranged at which lectures and demonstrations are given by the scientific staff, who also deliver public lectures on different aspects of the scientific work of the Institute.

In this way the Institute exerts a strong influence over the farming community of New Zealand and has greatly assisted in bringing about widespread appreciation of the importance of scientific research in agricultural improvement throughout the Dominion.

(Part II of this article, dealing with the New Zealand Wheat Research Institute, will appear next month.)

Research on Tropical Grain Drying

Grain storage and mechanisation for tropical grain production are dependent on grain-drying facilities. Recent research work at the Institute of Pan-American Agriculture in Costa Rica, conducted by the agricultural engineering department, has developed promising solutions to this problem.

A sack-type drier, a bin-type drier and trailer- or oxcart-type driers have been designed and developed to the point of practical use. Although further improvement will undoubtedly be desired, the use of these driers for their respective conditions will apparently solve in a most practical and economical manner the grain-drying problems for the small to medium-sized diversified tropical farms, as well as for any scale of mechanised grain production in American tropical regions.

Drying is as essential as planting, cultivating or harvesting for most tropical grain production, especially if the grain is to be placed in storage. Successful storage in humid, tropical climates demands adequate drying facilities to reduce the grain moisture content to 13% or below. In the case of rice, for example, which is generally combined at about 24% moisture content, the removal of approximately 8 litres of water per 100 lb. of dried rice is required. The present lack of storage in most tropical regions is due in a large degree to the lack of adequate drying facilities.

Much attention is now being given to the mechanisation of agricultural production in the American tropics, even in areas with favourable land conditions for machine use. A serious impediment to mechanisation has been the lack of suitable drying facilities; in fact, one of the major objectives of the drying research at the Institute was to develop a set of drying facilities for its own use, to make possible not only machine harvest, but also to be able to harvest and store, or prepare for market, those staples produced. Many crops have been completely or partly lost because of lack of drying facilities. So much has this been the experience of farmers in the region that only limited acreages of grain have been planted.

With practical means of solving these drying problems larger-scale mechanised production can be initiated with the assurance that harvesting and storage can be accomplished. The Institute is now in a position to proceed with a machinery, experimental and training programme and a basic long-term grain storage programme. Both will provide fundamental information for all the countries of tropical America.

Aerial photograph of an estate in the European reserve of Kenya which has been successfully laid out on modern soil conservation lines. Note the broad terraces carrying growing crops and the contoured drains discharging into grassed strips. The picture is taken after rain and shows the system in action

The Development of Soil Conservation in Kenya Colony

Part II The last Ten Years of the Half Century

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This is the second part of Mr. Maher's article, the first instalment of which appeared in our June issue. In it the author reviews developments in the past ten years and discusses the present position.

DESPITE the difficulties imposed by shortage of staff and machinery throughout the war period, the Soil Conservation Service made steady progress on farms in the European areas in the ten years ending in January 1951. During the first part of this period some 6,000 acres a year were broad-base terraced, necessitating the construction of over 600 miles of broad-base terrace a year, together with associated farm roads, drainage channels and diversion ditches. Towards the end of the decade the larger number of field officers of the S.C.S. and the greater number of tractors enabled the annual total area treated to be raised to over 10,000 acres, while latterly, the increase to 17 of the number of heavy tractors available for use on terracing brought within reach the aim of 20,000 acres a year, although the figure is still too low, bearing in mind that probably 500,000 acres have still to be dealt with.

Need for co-ordinated work

It was early evident that a run-off disposal system cannot be planned effectively on the basis of single fields. Indeed, where the gentle topography and long slopes make it necessary, groups of farms or complete river catchment areas may have to be planned as a whole, even though the subsequent construction work has to be spread over several years. Thus more than 100 sq. miles were surveyed and planned in a block by the Soil Conservation Service in the Rongai River catchment area in the Rift Valley.

Agronomic and economic considerations

A conservation plan on a farm depends only partially on the structures to conserve or dispose of surplus run-off water. If the plan is to be effective and practicable it must include a complete agronomic rotational programme, based on economic considerations, which will stabilise or improve the farmer's position. The lack of sufficient trained and experienced agronomic staff proved as great a drawback later in the decade as did the shortage of conservation staff and machinery a few years previously. It was found, too, that as insufficient staff and money had been made available for experimentation during the previous quarter-century, it was often difficult to propound a satisfactory farm plan in some districts, owing to insufficient knowledge of crops, pasture plants and farming systems likely to be suitable.

Developments in native reserves

By the beginning of this fifth decade the use of contour trash lines was being advocated in most African native areas as a palliative measure against erosion. The considerable success of terracing in the European areas and in parts of the Machakos (Ukamba) Reserve then led, however, to official acceptance of the desirability of the use of narrow-base terraces in the reserves to provide stronger defences against the ever-increasing peril of soil wash. No more terracing was done by

(*Left*) **Poor cotton on a steep slope, Meru Reserve, 1938.** (*Centre*) **Men digging narrow base terraces, Matungulu location, Machakos Reserve. Note instructor with land level stick.** (*Right*) **Bananas marking site of terrace bank in Kiambu Reserve. Terrace, built in 1940, now lost (photo taken December 1949)**

tractors in the reserves after 1938, but a few hundred acres were terraced by oxen, using small terracers or graders, in the Machakos Reserve and about 1,200 acres in the Kitosh (North Nyanza) Reserve. Despite fluctuating standards of maintenance, some of the latter were still in fair condition about seven years later.

Narrow base terracing

The bulk of the work in the native reserves was, however, narrow-base terracing by hand, performed under the stimulation of district agricultural officers, partly by communal labour gangs, working under old native clan systems, or under orders made by native councils exercising powers under the Native Authority Ordinance. In some districts, however, work was done by individual owners or cultivators, either working voluntarily or following orders from the local native authority.

Most of the narrow-base terracing was done in Central Province, in the Kikuyu and Kamba Reserves. Between 1942 and 1948 inclusive, over 230,000 acres were reported to have been terraced, with from three to five acres per mile of terrace bank. (It may be assumed that there are between 5,000,000 and 10,000,000 acres under arable cultivation from time to time in the native reserves of Kenya Colony. This estimate is very tentative, however.) The amount of work done increased steadily every year until 1948, when over 51,000 acres were terraced. In 1947 and 1948 these efforts were, however, hampered by political activities of certain of the Kikuyus, particularly in the Fort Hall Reserve.

During this time methods of erosion control by strip cropping and ' live wash stops ' were also used over large areas. Special efforts were made in the Kipsigis Reserve from 1946 onwards to develop the use of contour grass strips which not only reduce the soil losses on slopes by run-off, but also ensure that ploughing is done on the contour.

In Nyanza Province much less terracing was done. However, in 1948 about 208 miles of narrow-base terraces (covering 600 to 800 acres) were built in north Nyanza and about 74 miles (200 to 300 acres) in central Nyanza.

Defects and drawbacks

Government speakers in the House of Commons have not infrequently used statistics of these achievements in the native reserves of Kenya to refute allegations by Opposition speakers that there has been official neglect of the soil-erosion problem in East Africa.

However, it must be pointed out that, just as the planting of hundreds of thousands of sisal plants was not a short cut to the preservation of the soil in Ukamba, so the energetic campaign for constructing hand-made terraces, although it did much good, lacked many of the essential factors requisite for final success.

For example, most of the terraces were pegged out by African agricultural instructors using line levels—simple but not extremely accurate devices—on what were intended to be level contours. Three-foot vertical intervals between terraces were generally prescribed, but these often became 6-ft. or 9-ft. intervals, owing to the unwillingness of African farmers to undertake what they considered over-laborious operations—with consequent disastrous results.

Insufficient attention was often paid to the use of the land after terracing was completed; frequently there was uncertainty whether local Africans would use particular terraced areas for cultivation, grazing, or merely leave it to a ' bush fallow.'

Moreover, while terracing can, it is true, conserve moisture and prevent erosion, it cannot restore lost fertility. In some cases on steep land, substantial terraces were made which exposed so much unfertile subsoil as virtually to sterilise land which had already gone far towards barrenness, owing to over-use and erosion.

On some really steep land, with over 20% slope, terracing was carried out with results which could only be described as deplorable and, after the work had been done, the land was practically unusable. The digging of deep terraces at vertical intervals of 5 or 6 ft. left great banks of subsoil of little value for crop growth, which considerably increased the severity of the general slope, while in some places run-off of rain falling on the excavated earth passed almost directly into the steep cuts of the channels of the terraces immediately below.

It is impossible to standardise soil-conservation technique to cover all types of soil, slope and land use.

Methods employed at particular points must be determined by such factors as topography, soil type, rainfall intensities and temperatures, as well as by availability of markets, population densities, etc. On steep hillsides, as for example in the Fort Hall Reserve, it is unlikely that narrow-base terracing could be safely advised. More suitable would be strip cropping, strengthened by diversion ditches, bench terracing or grass strips, with permanent tree crops or belts of fodder crops such as elephant grass, forestry and so on.

Towards the end of the decade it had indeed become generally appreciated that bench terracing is a *sine qua non* if steep hillsides have to be used for arable purposes, and efforts were made both to introduce strip-cropping systems and to improve bench terraces in the Fort Hall district and in the Mbere district of the Embu Reserve, where a crude form of

bench terracing had been used many years go.

Disposal of surface run-off

Terrace outlets, protected against scouring by a grass cover, and diversion ditches, above blocks of cultivation, were rarely seen at first in the reserves, but from 1945 onwards, considerable mileages of grassed drainage ways were established in the Central Province, totalling nearly 18,000 miles up to the end of 1948. Doubtless many of them were not entirely satisfactory, since it is difficult to supervise the construction and maintenance of such a large mileage. However, the principle of setting aside drainage lines had been established and much good must have resulted.

Difficulties in native reserves

It is necessary to consider some of the inherent difficulties of procuring effective systems of soil conservation in native reserves. In a newly settled area there is no real physical, political, sociological or economic reason why the use of the land should not be planned and carried out on rational lines. It is true that, even under these conditions, the planning of new areas has frequently been unsatisfactory, but this has been due largely to lack of knowledge on the part of the planners or to the reactionary attitude of the African settlers. In already populated districts, on the other hand, it is far more difficult to bring about new methods of land use suitable to the conditions. The crops grown and the methods of farming are decided by traditions which may have arisen when the population was much smaller and the land much less intensively used, by the paramount needs of producing food for bare existence and by the markets available. Even though the existing methods of land use may be suicidal they may have to be continued, in default of alternative lands for settlement or of other ways of employment and subsistence. The cultivation on steep hillsides of erosion-conducive crops such as maize and cotton by a growing population can, however, only result in enforced migration at a future period, the date of which will be settled by the resistance to erosion of the particular soil type and other factors.

A primary difficulty in the past in replanning native areas has been that of securing contour maps; apart from physical obstacles, there is often strong opposition from politically minded Africans who associate surveying operations with suspected machinations of Europeans to secure African-owned lands. Nevertheless, it is obviously impossible to produce a satisfactory land-use plan without a good contour map on which drainage lines, soil types, degree of erosion and other information can be indicated.

Another difficulty is that of planning rational land use where there are claims to every square yard, where erosion-conducive crops such as cotton or maize are regularly planted in steep slopes, which properly should be under grass or trees, and where huts and cultivated patches occur in natural drainage lines, which should be kept free from obstructions and protected by a grass cover. Frequently it has happened that the political and sociological difficulties are so great that the existing misuse of the land has been allowed to continue rather than risk causing disturbances amongst the people. Inaction for political reasons, however, can only lead to a decreasing potential for production, perhaps to eventual stabilisation at a very low intensity of use, or even to rendering large areas completely valueless for any social purpose. This latter situation has arisen, in fact, in some parts of the semi-arid native districts in East Africa.

A very important point in the application of soil-conservation measures is the maintenance of terraces. If constant attention is not paid to cleaning out the channels and building up the banks, terraces may be destroyed rapidly and in a spectacular manner, especially in districts particularly subject to erosion owing to the nature of the soil and climate. It is virtually impossible to avoid the silting up of terraces if they are not combined with a farming system which allows the building up of the soil organic matter and promotes absorption of the rainfall.

Another important point is that land is frequently subject to run-off from above. This necessitates the provision of a cut-off drain above the cultivated area with sufficient capacity to carry any run-off likely to occur. Such ditches cannot be designed by guesswork but must be based on ascertainable facts, such as the area of the contributing catchment, estimates of run-off fractions and probable rainfall intensities.

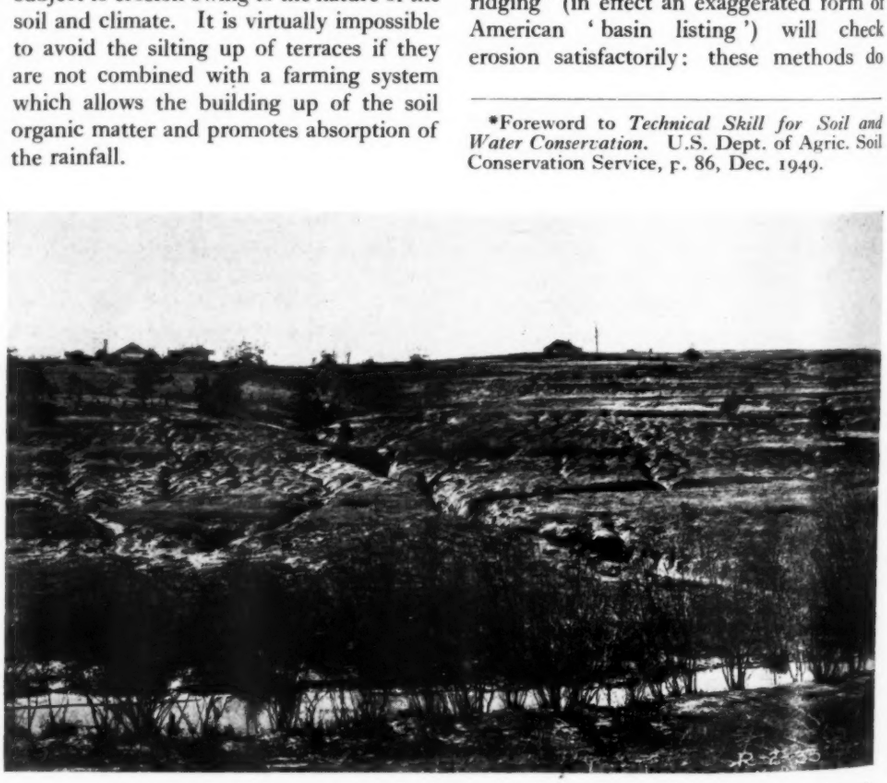
To quote Dr. Hugh Hammond Bennett, 'There is but one way to do soil and water conservation work so that it will be effective and permanent. The work must be done on whole farms, acre by acre, according to the land's capabilities and needs. Such treatment demands scientific and technical accuracy that can ordinarily be supplied only by technicians trained in soil conservation.'*

Summary and discussion

In the past 20 years a great deal of the soil conservation work carried out in East Africa—not merely in Kenya—has not been effective and permanent, largely because it has not been done with 'scientific and technical accuracy' nor by properly trained technicians.

In parts of East Africa where the slopes are gentle, the soils absorbent and rainfall intensities moderate, relatively simple techniques such as strip cropping and 'tie-ridging' (in effect an exaggerated form of American 'basin listing') will check erosion satisfactorily: these methods do

*Foreword to *Technical Skill for Soil and Water Conservation*. U.S. Dept. of Agric. Soil Conservation Service, p. 86, Dec. 1949.



The result of failure to maintain bench terraces properly. Note the network of small gullies and almost complete destruction of this field in South Carolina, U.S.A.

Ox terracing in the Mai Hills

not demand a high standard of accuracy in setting out and construction.

Elsewhere, however, a more complex system is required to deal with large volumes of potentially destructive run-off water, especially where storms may be very local but of very high intensity. In such areas so-called simple methods in the hands of unskilled farmers, officials or African peasants may cause severe deterioration of the soil.

It is, indeed, not too much to say that soil conservation measures which are not based on an overall land utilisation plan and a long-term farm programme at best can only be of partial benefit and at worst may be a complete failure, which will leave the land in a worse state that it was before. Thousands of acres of land in the southern states of the U.S.A. were ruined years ago by indifferent terracing badly kept up, and similar results may occur in the native lands of East Africa if adverse sociological factors and the absence of comprehensive plans prevent the development of conservation farming on rational lines. Appreciation of the value and importance of conservation measures and the general goodwill of the people are essential for their successful introduction.

The most difficult European farmer to assist is the ' practical man.' He may have initiative and the desire to start something, but he is usually too ' practical ' to realise that his ideas on soil conservation may be no more than third rate. Many officials also formerly held the view that anti-erosion measures are simply a matter of ' common sense ' and require no special knowledge of technique and, in consequence, some of the settlement schemes were laid out on a rectilinear plan in defiance of ' orthodox ' conservation planning founded on a contour survey.

Towards the end of the period under review, however, the necessity for basing layouts of group farms and settlement schemes on contours has begun to be widely appreciated. For example, rotations of green grass ley and arable strips planted on the contour are integral parts of the group farming schemes in the Kipsigis Reserve near Kericho; the Makueni settlement area south of Machakos will be developed on a topographical basis. In Nyanza Province, by the end of 1948, 27 group farms had been started, covering a total of 8,700 acres and including 420 African farmers. The farms were planned on a topographical basis allowing for terracing, strip cropping and a grassland-arable rotation.

In the European areas of Kenya Colony the work of the Soil Conservation Service, in collaboration with district agricultural officers, has become increasingly effective, as farmers have been assisted to prepare comprehensive long-term plans for their farms, in which general development and improvement are considered as an essential part of the conservation scheme. The development of a similar attitude in regard to the native areas is essential; but, as the technique of agriculture and conservation on African lands, from being largely hand-to-mouth, becomes more complex, calling for the resources of science in an ever increasing degree, it must be recognised that soil conservationists are specialist officers who have their own contribution to make to agriculture, just as have the plant pathologists, entomologists and pasture research officers.

Are You Paying Too Much for Too Little?

In Britain today farmers' actual expenditure on liming is not less than £6,000,000 a year, but does every farmer buy the kind of lime that will give him the best return for his outlay?

' Lime ' is used as a name for many materials, such as burnt lime, quicklime, ground carbonate, and waste lime from industrial processes. All are derived from limestone or chalk and have the same effect in the soil, but prices and liming values may show wide variations. If the price is right it does not matter which form of lime is used; for soil improvement one is as good as another if applied in the right quantities.

It is usually cheaper to buy lime from the nearest source. To the price of the lime at the producers' works must be added the costs of transport and spreading. If the type of lime selected has a low content of calcium oxide, then the farmer will be paying for transporting and spreading water or dirt. So it is uneconomic to haul low-grade materials over long distances. For example, the waste lime from the refining process at a sugar beet factory is excellent and cheap for farmers living nearby, but the delivered cost would be far too high if this material had to be carried, say, 50 miles.

The key to economy in liming is the final cost of a unit of calcium oxide spread on the land. Every farmer should calculate this cost before making his selection from the liming materials offered for sale. This unit cost is calculated by dividing the cost per ton of the spread material by the guaranteed figure of calcium oxide or its equivalent. For example, if ground burnt lime contains 80% calcium oxide and costs 60s. per ton spread, the cost of a unit is 720d. divided by 80 = 9d.; if ground limestone containing 50% calcium oxide equivalent costs 33s. 4d. per ton spread, it has a unit value of 400d. divided by 50 = 8d.

In England the Agricultural Lime Department of the Ministry of Agriculture pays half the cost of the lime delivered to the farm.

In recent years there has been a rapid increase in contract-spreading services. There are few districts today where a farmer is unable to obtain the services of a skilled contractor using specialised equipment. Some farmers may have a sufficient labour force to spread the lime themselves, but it is a good idea to estimate the cost and to see how it compares with the contractor's charges.

Swollen Shoot Disease of Cocoa in West Africa

AN IMPORTANT NEW DEVELOPMENT

THE recent announcement by the Colonial Office, that a method has been devised of treating cocoa trees with a systemic insecticide which causes the death of the mealy bug vector of Swollen Shoot disease, may mark an important advance in the struggle against this malady which threatens the destruction of the West African cocoa industry.

From time to time accounts of the position in this regard have appeared in WORLD CROPS; we may remind our readers that the disease is occasioned by a virus of which a number of strains exist, the most virulent of which causes the death of the tree within a period of a year or so. The disease is transmitted by mealy bugs and no remedy is known for the disease itself; the only method of control hitherto found to be effective is cutting out all infected trees as soon as they are detected, together with all trees immediately in contact with them.

A campaign for the control of the disease by cutting out has been instituted by the Government and is being vigorously prosecuted, but difficulties have arisen from time to time and, as was recently announced, the campaign has been temporarily suspended pending further investigation of the position by a specially appointed committee, known as the Korsah Committee, which is enquiring into the methods and organisation of the cutting out campaign.

Mealy bug control

Research on the disease has been unremittingly prosecuted by the West African Cocoa Research Institute for the past seven years and it has for some time been apparent that if some means could be devised of controlling the mealy bugs which transmit the disease it might greatly assist in securing the control which is so urgently required. Ordinary methods of control by spraying or dusting are ineffective by reason of the protection afforded to the insects by their waxy covering and the 'tenting' of them by their attendant ants. Some time ago it was suggested that a possible way of attacking the problem was by means of the new systemic insecticides, which are absorbed by the tissues of plants and render them toxic to sucking insects attacking them without affecting the plant itself or the quality of the produce, or harming any natural predators or parasites on the insects.

To investigate the possibilities a team of three entomologists was sent to the Gold Coast by Pest Control, Ltd., about two years ago, working in close association with the West African Cocoa Research Institute, and it is now announced that, as a result of their researches, a new systemic insecticide has been devised which promises to fulfil these requirements.

A first experiment at the Experiment Station of the Institute is recently reported to have given very satisfactory results. Very recently a second experiment was concluded on 500 cocoa trees and the result demonstrated to the Director of Agriculture in the Gold Coast and to the Director of the Commonwealth Institute of Entomology, who flew to the Gold Coast to see it. The results were also shown to the Korsah Committee.

In the second experiment specially excellent control of the insects is reported to have been obtained showing a mortality of 99.95% of all the mealy bugs present.

The chemical used is a new systemic insecticide specially developed for Gold Coast conditions by Pest Control Ltd., and it is proposed that this chemical be named Hannane after Dr. Hanna, well-known entomologist and leader of Pest Control research team. This chemical is highly poisonous and should only be applied by specially trained operators under medical supervision. Owing to the poisonous nature of the insecticide, food crops in close proximity to the treated trees will have to be removed. The insecticide is applied to the ground at the foot of the tree from whence it is taken up by the feeder roots and transmitted through the sap stream over the entire tree. The sucking mealy bugs absorb the poison while feeding and are killed.

It must be remembered that the insecticide kills only the mealy bugs, while the swollen shoot virus in the tree is not affected. The insecticide remains active for eight weeks in the tree and apparently does not harm the pollinating insects or beneficial predatory insects which feed on the mealy bugs.

Methods of application

Further progress has also been made in the method of application, which is being simplified. The method of root application is novel and well adapted to conditions of the West African cocoa farms and does not require any machinery. A field experiment on three acres of swollen shoot infected cocoa is now in progress at the West African Cocoa Research Institute on a farm representative of the conditions prevailing in the devastated areas, and it is hoped to carry out larger-scale experiments in areas where isolated outbreaks occur. Although results to date are encouraging, it is imperative to secure verification that there is no contamination of the cocoa bean in order to meet with the requirements of the Medical Research Council in Britain and the Food and Drug Administration in the U.S.A., and, further, to confirm that there is no lowering of the quality of the cocoa beans so as to reassure the chocolate manufacturers. The Managing Director of Pest Control Ltd. has stated that experiments by their radiotracer method have shown that the insecticide is decomposed in the cocoa plant, and particularly in the pods, so that after the harvesting and fermenting no traces are left in the cocoa beans.

The outlook

Subject to the above and any unforeseen developments, experts of the West African Cocoa Research Institute and Pest Control Ltd. believe that the application of this insecticide, together with the cutting out of visibly infected trees, will avoid the necessity for more than one or two cuttings and so minimise the number of trees which have to be sacrificed. If everything goes according to the scientists' expectations, a general application of this systemic insecticide should be possible in approximately six months' time. It is hoped that this will put the control of the swollen shoot disease in the important cocoa areas of the Gold Coast within reach. The time taken to achieve control will then largely depend on how vigorously the application of the systemic insecticide and the cutting out of the diseased trees is pursued.

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Rescue wheat. Left, untreated, seeded with 1½ bushels/acre; right, treated with 2 oz. ' Mergamma ' C, seeded with 1 bushel/acre

Wireworm Control in Cereal Crops

In the Prairie Provinces of Canada

G. WATTS PADWICK, M.Sc., Ph.D., D.Sc.

Imperial Chemical Industries

The control of wireworm in cereal crops by the use of seed dressings of BHC has attracted much attention in Britain recently. The extension of this mode of treatment to the vast prairies of Canada is a more recent development. Dr. Padwick has carried out extensive trials with the product known as ' Mergamma ' C in collaboration with the Canadian agricultural authorities and farmers in this region, the following account of which is abridged from material supplied by Plant Protection, Ltd.

WIREWORMS are pests of cereals and other crops in many parts of the world. In the prairie provinces of Canada it is considered that at least one-third of the wheat-growing land is moderately to heavily infested, while much of the remainder carries a lower population of wireworms causing a continual drain on the crop.

In Britain wireworms have long been regarded as serious pests capable of doing much damage and difficult to control. In the past no satisfactory chemicals were available for their destruction. Cultural methods were only a palliative, for the wireworms live for at least five to seven years in the soil before pupating and emerging as click beetles. Work carried out in the laboratories of Imperial Chemical Industries Ltd. near Bracknell, England, led to the discovery during 1942 and 1943 of the insecticidal properties of the gamma isomer of benzene hexachloride (BHC) and of the fact that wireworms are especially susceptible to the chemical. Although the chemical was first applied to the soil, it was soon found that excellent results could be obtained by dusting it on to the seed. From a quite early stage (1945) experimental samples were sent by I.C.I. to the Dominion Laboratory of Plant Pathology at Saskatoon. Dr. A. P. Arnason and Mr. W. B. Fox experimented with these samples at various places and confirmed that the wireworms occurring on the prairies (chiefly *Ctenicera aeripennis destructor* Brown and *Hypolithus nocturnus* Esch.) are effectively controlled by the dressing.

In 1950 it was decided to lay down a number of demonstrations with the seed dressing to popularise this method of wireworm control. The product, sold under the name ' Mergamma ' C, contains 40% gamma BHC and 2% mercury as organo-mercurials. The latter is included for the control of seed-borne diseases.

Arrangement of the demonstrations

It was decided that there would be two distinct classes of trial or demonstration of the use of ' Mergamma ' C. In the first group there would be replicated trials on the Illustration Stations. These would give yield results suitable for statistical analysis, and at the same time would serve the purpose of major demonstrations on field days. The second group would be simply treated strips laid down in fields otherwise untreated. The farmers would be selected partly by district agriculturists and agricultural representatives, and partly by Chipman Chemicals Ltd., and they would serve as subsidiary demonstrations. For both Illustration Stations and farmers' fields 2 lb. of ' Mergamma ' C (sufficient to treat 13 acres at the recommended rate) were supplied to each co-operator.

The numbers of samples supplied were:

To Illustration Stations:	
Alberta	11
Saskatchewan	10
Manitoba	2
To Farmers:	
Alberta	53
Saskatchewan	207
Manitoba	11
British Columbia	3
Total Number of Samples Distributed	297

In the event there proved to be little difference between the demonstrations carried out on Illustration Stations and those at ordinary farms. The lateness of approach made it difficult for the supervisors of Illustration Stations to arrange replicated trials. Moreover, the majority of Illustration Stations, perhaps because of their better farming methods, seemed to have only a minor wireworm problem. Farms adjacent to Illustration Stations were chosen instead, and the designs of the experiment had to be simplified. Several well-designed trials were laid down by Illustration Station's staff near Scott, Sask.; as luck would have it, for the first time in several years, wireworms caused little damage in these areas. Thus the majority of trials arranged through Illustration Station supervisors turned out in the end to be in the nature of demonstration strips comparable with those in ordinary farmers' fields, and in the following paragraphs no distinction is made between the two classes of demonstration.

Observations

The writer was able to visit, during the summer, 108 of the demonstrations, and to meet the farmers concerned in all but about half a dozen instances. Numerous problems were discussed with the farmers, and many questions asked. There seemed to be a fairly accurate appreciation of the damage done by wireworms, and a good deal of knowledge about the conditions which favour their development. Most farmers, for instance, knew the particular areas in any field where the crop suffered damage, often being able to map it with considerable accuracy; most of them recognised that damage is usually severest after summer fallow, and that poor growing conditions following seeding intensify the damage; many considered deep seeding a contributory cause, and packing the soil to be beneficial. Most of the farmers had only a vague knowledge of the life-history of wireworms—hardly any, for instance, knew that they live on the average five to seven years in the larval form; many did not know that the adult stage is a beetle. The farmers' problems were discussed as far as time permitted, and questions were asked about the method and rate of seeding, method and rate of treatment, etc. The fields were visited and the results visually assessed. In more than 40 cases sample plant population counts were made in treated and untreated areas.

Methods

The methods used in taking these counts were:

(1) In the case of drilled crops, paired one-yard rows were taken at random, by walking along the junction between a treated and an untreated area, throwing a yardstick on each side, laying it along the nearest row, and counting the plants.

(2) Where the crops were seeded with an attachment to a 'one-way' disc cultivator paired counts were taken in a manner similar to the above by use of a 1-ft. wire quadrant, which was thrown on either side of the line separating the treated area from the untreated.

Results

The following facts emerge:

(1) 16 of the 107 samples supplied for cereals were not used.

(2) 14 demonstrations were invalidated because the whole field was treated, or the crop was destroyed by drought, or for some other cause.

(3) The 77 samples remaining were used on the following crops: Wheat, 71; barley, 5; oats, 1.

(4) There was little or no wireworm damage, and no visual difference between treated and untreated areas, in 33 demonstrations.

(5) 44 demonstrations remain. In 36 of these there was a clearly noticeable difference between the treated and untreated areas favouring the former, as judged by visual examination. Of this number, 24 were striking instances of the efficacy of 'Mergamma' C in ensuring a thicker stand; in the remaining 12 the differences were less striking but still evident.

(6) In a further four demonstrations the 'Mergamma'-treated areas were reported to have had a thicker and more even stand shortly after germination, but the treated and untreated areas were indistinguishable at the time of examination.

(7) Four demonstrations were apparent failures, 'Mergamma' C seemingly not having controlled wireworm injury.

(8) It was thought that the method of seeding used might influence the effectiveness of 'Mergamma' C. As far as could be seen, the method of seeding, that is to say, with an orthodox seed drill or a 'one-way' disk seeder or similar type of adapted disk cultivator with a seed-box attachment, did not influence the effectiveness of 'Mergamma' C. The number of cases of very striking visual differences where the orthodox drill was used was 14 out of 40, and with the 'one-way' or adapted disk cultivator 8 out of 21. Enquiries are being made into the seeding method used in the case of the four failures.

(9) 34 of the farmers found 'Mergamma' C unpleasant to use, as they do most other mercury seed-dressings; there were probably others who objected to it but did not complain. A few of the farmers found the material highly objectionable and might be deterred from using it. Very few farmers used any form of protection of the eyes, nose or mouth; a few used a flimsy cotton mask.

(10) In many cases the method of seed treatment was crude, as the following analysis of 55 enquiries shows: Treated with an approved seed-dressing machine, 30; treated by mixing with a shovel on the floor or in a wagon box, 23; mixed in the seed-drill grain box, 2.

(11) There was a single trial on sugar beet in Western Canada, namely, at Coaldale, Alta. The 'Mergamma' was applied in addition to 'Ceresan,' but the farmer could not state the rate of application of the dressing. The 'Mergamma'-treated area formed the bulk of the field, but there was a fairly wide untreated strip on each side. At the time of examination, on June 4, about half the field had been thinned, so that the 'Mergamma'-treated and untreated areas could be compared on one side of the field in unthinned beets and on the other side in thinned beets. No significant differences were found in plant population in the unthinned area. In the thinned portion the treated part had a plant population of 93 per 100 ft., and the untreated only 76, the difference in stand being significant.

Discussion

It is interesting that about 90% of the samples used were applied to wheat, although wheat occupies only 60% of the area devoted to cereals on the prairies. Many of the co-operating farmers declared that oats and barley do not suffer much from wireworms. That they *can* suffer severe damage is a well-known fact, but it is probably true that in Western Canada they are affected less than wheat. There are two reasons for this: firstly, that oats and barley commonly follow wheat, whereas wheat often follows summer-fallow, which results in maximum damage; secondly, oats and barley are sown later

Wheat. Left of stake, untreated; right, treated with 'Mergamma' C at 1 oz./acre

Rescue wheat. Foreground, seeded with 1 bushel/acre, untreated; background, over-seeded with a further bushel and treated with 2½ oz. 'Mergamma' C

than wheat, and sometimes miss part or all of the active spring feeding season of the wireworms.

Over 50% of the demonstrations which escaped the hazards of drought, bad seeding, bad layout, wind damage, and destruction by grass-hoppers, were of almost no value because wireworms did no damage in the untreated areas. In a small proportion of these, wireworms were not known to cause damage on the farms, and the sites were therefore unsuitable. In most instances, however, wireworms were known to be present but failed to feed even on the untreated wheat. Admittedly, it was an unusual season, wheat being sown at least a month late, whereafter growth was rapid for several weeks and the soil surface was warm. This may explain poor feeding. We are aiming at *killing* a good percentage of wireworms, and presumably this will not occur if the wireworms remain well below the zone of treated seed, and moreover, farmers are loath to spend a considerable amount of money on a treatment which may or may not be necessary. One of the positive things learned from these tests where wireworms did not operate is that there was no apparent phytotoxic damage due to the treatment. This is gratifying considering that the rate of application per bushel was often heavy, but it must be remembered that the material was distributed late and the grain could not have been stored long after the treatment. At the recommended dosage when the seeding rate is 1 bushel per acre, the seed carries a mercury load of 65 p.p.m. Whether this could cause damage if treated grain were stored for some weeks or months before sowing is a point receiving attention.

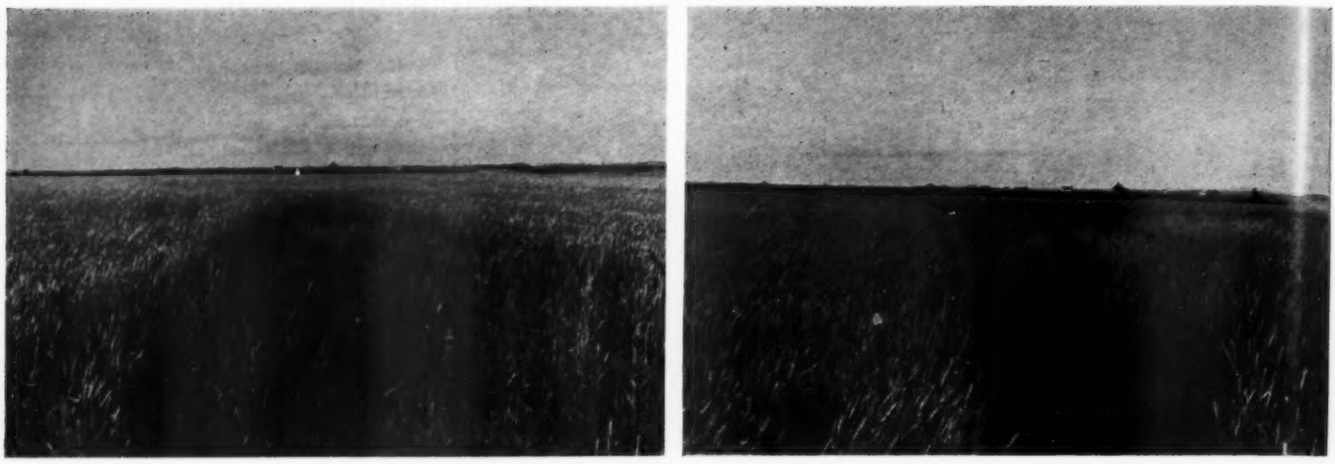
In 36 out of 44 demonstrations where wireworms caused damage in the untreated area, the treatment brought about an improvement sufficiently great to be distinctly noticeable at the time of the visit; four more had shown a marked difference shortly after germination, but the difference could no longer be seen at the time of the visit. There were only four apparent failures to control wireworm damage. We have insufficient data to say why 'Mergamma' C failed in these cases, though possible explanations are (1) unduly deep seeding, (2) seeding under very unfavourable (especially cold or dry) growing conditions which lengthened the period when the plants were most susceptible to damage, and (3) scattering of the seed and uneven depth of seeding due to use of a 'one-way' disk seeder. We hope to learn more about these points.

There were only three cases of the use of half-rate applications. In two of these there was no wireworm damage even in the untreated controls. In the third the rate of application was only two-fifths of the full rate; an excellent increase in stand resulted, but there was still room for improvement and better results might have been obtained with the full rate. Most farmers to whom we spoke expressed a preference for the full dosage and a maximum kill, rather than attempt to save by using the half-rate dosage. As this simplifies somewhat the problem of disease control (which may be unsatisfactory at the half-rate applications when the seeding rate is fairly heavy), we believe it best to stress the full-rate application and make only brief mention of the half-rate.

Conclusion

A great deal of improvement is needed in the method of treating the seed. A little over half the farmers used an approved seed-dressing machine, based on gravity feed. Too high a proportion of the farmers mixed the dressing with the grain by shovelling the two together on the floor, which can hardly result in a good mix. Some of them even chose a breezy day and did it out-of-doors to avoid contact with the unpleasant dust!

Many farmers find the dust somewhat disagreeable to use, though none complained of any serious effects. Most considered it no more objectionable than a



Two sections of the same field. *Left,* **a corner of an untreated triangle of the field where the farmer ran out of seed dressing.** *Right,* **2½ oz. Mergamma/acre applied to left section; rest of the field was untreated**

typical mercurial seed-dressing and would not be deterred from using it on account of its rather unpleasant smell.

The cost of treating seed with 'Mergamma' C, or 'Abol' seed dressing which contains gamma BHC only, is too high to justify a 'blanket' treatment of all the crop sown merely as an insurance against possible wireworm damage. It should be the aim of all concerned with the development of the use of these products to see that maximum benefit is obtained and that disappointments are avoided. This can best be assured by following certain rules, namely:

(1) Treat only seed which is to be sown on land where there is a history of wireworm damage or wireworms are known to be present.

(2) Remember that wireworms do more damage on crops following summer fallow than on stubble crops; other factors encouraging wireworms are seeding on ploughed up brome or other grass leys, sowing under poor growing conditions, and sowing in a loose seed-bed.

(3) See that the dressing is thoroughly mixed with the seed by using a suitable seed-dressing machine. Do not treat in the open in windy weather to avoid the unpleasant effects, but instead treat indoors or outside in still weather, and take the precaution of providing some protection to the nose and throat—preferably using a respirator, or at least using a cotton mask.

(4) Avoid excessively deep seeding.

(5) Avoid undue scattering of the seed when using a 'one-way' seeder.

(6) Keep in mind that a firm seed-bed is still desirable even when using the dressings.

Photos by Dr. G. Watts Padwick, I.C.I., Central Agricultural Control

NEW BOOKS

Silage

By S. J. Watson and A. M. Smith. Pp. 143. Illustrated. Crosby Lockwood, 1951, 10s. 6d.

The importance of silage in British livestock farming cannot be over-emphasised, although until comparatively recently it was too often neglected and overlooked in cropping programmes. Consequently this book by Professor S. J. Watson and Dr. A. M. Smith is to be specially welcomed since both authors are recognised authorities, particularly well qualified to write on this important subject.

The days of cheap imported feedingstuffs are gone and unlikely to reappear for many years. Meanwhile, livestock production is being encouraged more than ever and the bulk of foodstuffs required for this expansion must be grown at home. If there is one crop for which the British soil and climate is pre-eminently suited, it is grass—that is in its widest sense, including legumes such as clover and lucerne. Conservation of grass can be effected by drying, haymaking or ensilage and, of the three, the last-named is the most generally suitable. For a farm with a small acreage of grass the installation of a drier is not usually economic; haymaking in many parts of the country (particularly the west) is a chancy business at best; and so ensilage would appear to be, generally speaking, the most suitable method of conservation.

As the co-authors of this book point out, the war-time silage campaigns did not obtain the results hoped for. Many farmers thought that the reorganisation of their cropping for, as they imagined, the duration of the war was not justified and if they did make silage at all it was in a somewhat casual manner. Now, many more are making silage regularly and regard the operation as one of the recurring jobs of the farming year, just as are muck-spreading, hoeing and haymaking. However, there is still a vast amount of material capable of being made into silage, much of which is at present lost, and the authors of this work advocate a more general recognition of silage as an essential part of dairy and beef farming, as is the case in North America and New Zealand, where almost every farmer who has stock to feed makes silage in one form or another.

As can be imagined, a full-length book of 129 pages of text is likely to cover the subject fairly comprehensively. The history and world use of silage, suitable crops for ensiling, their harvesting and methods of ensilage are described and food values and rationing tables also given. Other aspects dealt with include the biochemical changes in the ensilage process, the construction of silos and other containers and the cost and relative value of silage.

The appearance of this book is timely and it can be read with pleasure and profit by those already converted to silage-making as well as by newcomers to this important farm practice. It contains 16 pages of admirably reproduced photographs, clearly illustrating various aspects of silage-making. It should find a place on the bookshelves of all progressive farmers, dairymen and stock-raisers, not only in Great Britain but also overseas, since although the information it provides is primarily related to British conditions, much of it is generally applicable to other countries as well.

British Plants and their Uses

By H. L. Edlin. Pp. viii and 152. Illustrated. Batsford, London, 1951, 15s.

This somewhat all-embracing title is fully justified by the contents of the book. The author has selected all the useful plants, wild and cultivated, that flourish in Britain today and classified them by their uses rather than by the more conventional botanical divisions. A general description of each plant, including its manner of growth and cultivation, is given and its relationship to others having allied uses is brought out. Past developments and present position in rural economy are also given. In short, the author has written a clear, semi-popular and not too technical account of something like 450 distinct species of plants, all of which have their uses, ranging from medicinal herbs to peat mosses or thatching straws. Although some of the plants mentioned have now largely disappeared as sources of economic importance, it is an intriguing thought that there are so many and varied plants which serve useful purposes—and that is excluding timber trees, ornamental plants and edible fungi, which are not considered in this book.

The book is full of snippits of information. Who knows, for instance, that jelly made from the scarlet berries of the rowan is the proper seasoning for a joint of venison? Or that in certain areas of England marram grass was once made into shoes? There are over 110 illustrations, including photographs and many line cuts in the text, which help to make the whole an extremely varied and erudite book.

Gall Midges

Of Economic Importance. Vol. v on Trees. By H. F. Barnes, M.A., Ph.D. Pp. 270. Illustrated. Crosby Lockwood, 1951. 15s.

Volume V of this series provides further evidence of the painstaking thoroughness of the work of Dr. Barnes on the gall midges, those small and fragile insects which, in many cases, are of definite economic importance.

In this volume, a vast amount of information drawn from a bibliography of some 500 titles, most of which were consulted by the author, is collated and presented succinctly. To this is added a comprehensive list of the generic, specific and popular names of the gall midges under discussion.

The book is divided into two sections, the first dealing with gall midges of coniferous trees and the second with those of the broad-leaved trees, each section preceded by a list of the species concerned.

In his introductory remarks to the first-mentioned section, the author draws attention to the involved synonymy of the scientific names employed to denote the coniferous trees, and to the unfortunate results in naming midges after them in cases where confusion exists with regard to the correct generic name of the tree with which the midge is associated.

Where confusion does not prevail, naming insects after the generic name of a plant may be helpful in certain cases, but when an insect is associated with many and often unrelated plants, naming in this way is of questionable value, more so since it may not always be certain that the plant in question is the preferred host. Unfortunately, naming in this manner is not infrequent.

Among the other many interesting features of this volume must be mentioned the information regarding the trade names and commercial uses of the wood and other products of the trees, such as nuts and resins. Also, the alternative names of the timber are mentioned ; this should be of great service in clearing up such confusion as may exist.

Eight excellent plates and an extensive bibliography greatly enhance the undoubted value of the present volume for all workers in forestry, as well as for those whose main interest is in the group of insect with which it deals.

N. C. E. M.

To Authors and Readers

The Editor and Publishers of WORLD CROPS will be glad to consider manuscripts of books submitted for publication. We already publish a number of books on technical subjects, all of which find a world sale and most call for regular reprints and new editions.

Books of a non-fictional type in any language by any publisher can be supplied by the Book Department of WORLD CROPS.

Medical Botany

By Dr. Alexander Nelson. Pp. xi and 544. Illustrated. E. & S. Livingstone, Edinburgh, 1951, 30s.

This book is written primarily for the use of medical men, both general practitioners and specialists, and for veterinarians. It is intended to provide a handy compendium of information on the nature, composition and properties of foodstuffs and drugs of vegetable origin. It is a companion volume to the author's earlier work, *Introductory Botany*.

The first four chapters are concerned with the general composition of vegetable foods and the materials contained in them, their chemical constitution, the relationships of plant structure to food quality, their mineral constituents, vitamins and so forth. The fourth chapter deals with questions relating to storage, processing and cooking of vegetable foods.

The second and most substantial part of the book deals with particular vegetable foodstuffs and treats of a wide range of crops, including cereals, pulses, certain oil-seeds, a large number of fruits and leaf vegetables, with a special chapter on seaweed.

The last section is concerned with various drugs, and there are two final chapters, one on plants as causes of diseases and another on their identification.

The book contains a wealth of information concisely and readably presented. It should be of value to the circle of readers for whom it is primarily intended, while it could also serve a very useful purpose as a handy work of reference for many others, including farmers and agricultural workers, food chemists and others. The book is admirably printed, while the plates are well reproduced and usefully supplement the information given in the text. It has an excellent index.

Crop Protection Conference: Subjects Announced

At the conference on crop protection to be held at Fernhurst, Hampshire, under the auspices of Plant Protection Ltd. from June 26-28, six main subjects will be discussed, the programme being divided into sessions and each session being presided over and the discussions opened by leading agriculturists and scientists, as mentioned in WORLD CROPS last month.

The subjects chosen for discussion are as follows: (1) the wastage of world food supplies through pests and diseases; (2) chemical weed control; (3) synthetic organic insecticides—their value and limitation; (4) control of plant virus diseases; (5) fungicides, their development and uses; (6) factors limiting protection progress.

Summaries of the papers translated into French and Spanish will be prepared for delegates, and the proceedings of the conference will be published in full in several languages for world-wide distribution.

Water Development in Bechuanaland

THREE pilot projects to test a swamp clearance scheme in the Bechuanaland Protectorate have been approved by Mr. P. C. Gordon-Walker, Secretary of State for Commonwealth Relations. A special grant of £28,000 for the purpose has been allocated under the Colonial Development and Welfare Act, bringing the total amount so granted for water development and irrigation in the territory to well over £400,000; the total cost of the full swamp clearance scheme, which may be undertaken if the pilot projects prove successful, would amount to £1,500,000.

The Bechuanaland Protectorate, a territory administered by the Commonwealth Relations Office, lies between the Rhodesias and the Union of South Africa, and covers some 275,000 square miles. Geographically it falls into three areas: The eastern section or railway belt, where the majority of the population live and which is excellent pastoral country; the central zone of the Kalahari Desert, which includes some three-quarters of the Protectorate; and the north-western zone, an area in which the Okavango and Chobe rivers empty themselves into vast swamps.

In the past many schemes have been suggested for irrigation in the north-western area, known as the delta triangle, which is to be the site of the new pilot projects, but, owing to the practical difficulties, none have yet been followed up.

Scotch cart travel. Going through flooded country beside the Okavango River, Bechuanaland

Survey of water resources

At the suggestion of the Colonial Office, Prof. F. Debenham, of Cambridge University, paid a six months visit to Northern Rhodesia, Nyasaland and the Bechuanaland Protectorate to survey the water resources of those territories. In his report, published in 1949, Prof. Debenham made recommendations for water development in each of the three main areas of Bechuanaland, and outlined a scheme for swamp drainage in the delta triangle whereby a number of controlled channels would carry the water on to a deep reservoir or make it available for direct use on the land. The Okavango delta itself, the report says, would, however, have first to be surveyed. In the professor's opinion the choice of practical schemes from an engineering point of view is fairly wide, and there is nothing inherently impossible in making use of the abundant waters now going to waste. He points out that in course of time the region, with its ample water supplies, could become ' a second Sudan,' growing cotton or other products for export under similar conditions, provided there was reasonable access to the sea. In his view the possibilities for developing the Okavango swamplands depend far more on lines of communication than on engineering considerations.

Prof. Debenham also makes suggestions for developing the water resources in the remaining areas of the Bechuanaland Protectorate. He considers that in the Kalahari Desert zone there are impressive possibilities for water development along the Nata river, and far more prospect here of quick returns on capital expenditure than in many other areas of the Protectorate. His proposals for the railway zone, which is less flat than the rest of the territory, and where surface conservation is therefore possible, include irrigation, the provision of a greater number of watering points for stock, the utilisation of sand rivers and an increase in the number of bores and wells.

Present achievements in water development

The Bechuanaland Protectorate supports over a million cattle, which form the mainstay of the territory's economy; the majority are to be found in the eastern or railway zone, and it is here that most water conservation work has been achieved.

The Protectorate Government, with the aid of grants under the Colonial Development and Welfare Acts, has been drilling for underground water since before World War II, but in most places drilling is hard and, therefore, expensive. Nevertheless, numbers of boreholes have been provided at the larger centres of population and in grazing areas all over the countryside and are equipped with motor pumps or animal-gear pumps which can be worked by oxen. The people themselves, many of whom have had mining experience in the Union and know how to handle explosives, have in many places where water is available, used their own initiative and sunk good wells down to 80 ft. deep.

The Government has now started a system of regular maintenance for pumping equipment; maintenance gangs are placed in charge of about 25 pumps each and are visited regularly by a mechanic with a small travelling workshop who is responsible for the necessary repairs. The Government pays for the maintenance units, while the Native Administrations pay for caretakers at the pumps and for fuel and spare parts.

Apart from the drilling of wells, the Administration has also instituted the conservation of surface water by the construction of small stock dams with an average capacity of 1,800,000 gallons each. Work has been slow up to the present owing to the lack of the requisite machinery but it is planned to get equipment which will enable two tractors to construct one dam every five weeks at an average cost of £150 each. The dams are built in remote areas in order to get the cattle away from overgrazed areas; sites are chosen in consultation with Native Administrations, and the local people contribute by clearing the site before the arrival of the tractors and by fencing the dam when it is completed.

Photo: London Missionary Society

Stock and Scion Incompatibility

Members' Day at East Malling Research Station

THE relationship between stock and scion in budded and grafted plants is a matter of perennial interest to fruit growers and horticulturists. The long known fact, that while some stocks readily unite with scions grafted or budded on them and enable the latter to make satisfactory growth others do not, has always savoured somewhat of the mysterious, and consequently advances in knowledge of the factors influencing this process are of considerable practical importance.

The question of incompatibility formed the subject of a Members' Day at East Malling Research Station on May 17 last, at which some results of recent research were described and demonstrated. The meeting was presided over by the Director, Dr. F. R. Tubbs, who outlined the scope of the programme and introduced the various speakers.

Williams Bon Chretien Pear on Quince A rootstock blown off at union

Williams on Quince A with bridge, which five years after inserting is much thicker than the original stem (seen on left)

Williams on Quince A with two bridges which are rapidly taking over the functions of the original trunk

Symptoms and possible causes of incompatibility

The first speaker, Dr. Beryl Beakbane, referred to the mystery surrounding the development of a bud or graft on a tree. When the two parts grow together and form a healthy union the partnership is termed compatible, but when the partners fail to grow together satisfactorily the combination is termed incompatible. Incompatible combinations show various symptoms ranging from weak union, poor growth and death of young shoots to various abnormal leaf colours and early defoliation. Grafting in itself does not involve any reduction of health or vigour, in fact plants can be made to grow better by grafting on to a suitable partner than alone and trouble arises only with certain combinations. The most common incompatibility is probably that of certain pears on quince, and it is interesting to note that some of the combinations that have proved incompatible at East Malling, such as Williams on Quince and Sweet Cherry on Mahaleb, are said to be compatible in France and certain other parts of the world.

A variety of characters that might be causes of incompatibility have been suggested, *e.g.* period of cambial activity, seasonal growth of shoots, chemical interactions, rates of callusing, physiological and biochemical differences, mechanical blockage of the union and infection with virus. Some important advances have been recently made by a postgraduate worker from Spain, Dr. J. Herrero. He has since returned to Spain and Dr. Beakbane outlined some of the more interesting of his experiments, involving many combinations of single and double worked plums, pears and peaches. Particularly interesting was the anatomical structure of incompatible unions that could be broken cleanly, such as that of Reeve's Seedling on Myrobalan B.

Dr. Beakbane gave a simple description of the different sorts of tissues composing the wood, cambium, inner and outer bark and corky outer layer, explaining the differences in structure and function between vessels and fibres, phloem and medullary rays. She showed the importance of the close knitting together of vessels and fibres, phloem and medullary rays at the graft union, to the mechanical strength of the tree, and to the correct functioning of the phloem in the transport of sugars from the leaves to various tissues for immediate use or storage as starch. The cambial cells divide regularly during the summer months to form wood on the inside and phloem on the outside, and while

it is active the bark readily lifts from the wood or ' runs ' as the nurseryman says. The correct functioning of the cambium on each side of a graft union is most important; the check to its growth in incompatible unions was shown by diagrams and photomicrographs. In many cases it is possible to tell whether a particular combination is compatible by examining the union, but in doing so the tree is destroyed. Recent work on the distribution of starch in different parts of the plant seemed to offer a more consistent diagnosis and it has the advantage that it is not necessary to destroy the plant in examination.

Possible influence of starch

The next speaker, Miss Barbara Mosse, described a series of single- and double-grafted trees, building up models of each combination with red, white and black blocks, and surmounting each model with a label to show if it was compatible or incompatible. Certain combinations can be compatible with one partner as scion but incompatible when this partner functions as rootstock—thus peach grafted on plum is incompatible but plum on peach is compatible. She also showed that two varieties separately compatible on a rootstock, as Victoria and President are on Myrobalan B, can be incompatible when double grafted, as happens when Victoria is worked on President on Myrobalan B. Examination of the distribution of starch above and below the union showed that there was a lack of starch below incompatible unions, even where the structure of the wood across the union was apparently normal. Sucker shoots on the intermediate were not effective in reducing the incompatibility nor in putting right the lack of starch in the roots.

She had discovered abnormalities in the structure of the inner bark, that may precede the lack of starch. Such abnormalities are visible in the roots of maiden trees with the aid of a microscope, and associated with them there are often small black spots in the wood visible to the naked eye. It should now be possible to forecast incompatibility between new scion varieties and rootstocks at two or three years old. It might even be possible to select out of a batch of, say, Williams on Quince A at planting time, those most likely to survive in the plantation without breaking off at the union.

Double-working in the nursery

Mr. R. J. Garner showed the ease with which Williams grafted on Quince A broke off at the union and how this should be prevented by double-working in the nursery. In this a composite scion is made

Section through union between Williams and Quince A showing discontinuity of wood and bark. The scion wood is dark due to rapid oxidation of the tissues

by grafting a piece of Williams on to Beurre Hardy; this can be stored or used at once just as a normal scion, for grafting on to a Quince rootstock in the nursery, and the resulting maiden grows as quickly as a normal grafted tree. He also described and demonstrated various ways of correcting the incompatibility of an already planted Williams single-worked on Quince, including bridging with a simple bridge of Beurre Hardy or with a composite bridge of Hardy whipped on Quince, and bridging by veneer graft, with a patch of Hardy rind laid in a window cut out over the union.

Mr. Garner then showed that plums suffered from similar incompatibilities. It was not necessary to resort to double-working for these as alternative compatible rootstocks were available. In the case of cherries, however, there were no compatible rootstocks to produce bush trees in this country. In Australia these were grown on Kentish cherry, but our sweet varieties were incompatible on this stock in England. In an effort to find out why this should be, they had imported complete trees on Kentish cherry from Australia and these were seen to be still alive though growing rather weakly. Mr. Garner then showed some young double-worked trees using Frogmore or Carnation as an intermediate for Napoleon; Carnation appeared especially promising.

Seedling pear stocks

Mr. T. N. Hoblyn discussed the use of free pear rootstocks instead of Quince. This is common in the U.S.A. where seedlings of Bartlett pear are widely used. In the U.K. however, we have no easy source of seed, and trees on pear stocks are regarded as too vigorous for our needs. Growers demand medium sized, easily controlled trees such as those produced on Quince stocks.

In the early years Hatton and Amos compared three varieties of pear on graded pear seedlings, grouped according to botanical characters such as leaf shape, and on quince, and found that the traditional vigour and slow cropping on pear was not always borne out. Thus although Pitmaston and Emile D'Heyst were more vigorous on pear than on Quince, Durondeau was not, and while Pitmaston and Durondeau were slow to crop on pear, Emile D'Heyst cropped just as well on pear as on quince. Nevertheless there is an obvious need for pear stocks to produce vigorous and medium-sized trees respectively, and Hatton collected some 2,500 seedling pear stocks from various sources; these were sorted out on botanical characters and ease of propagation, and eventually 18 were selected for trial and grafted with Dr. Jules and Reine des Poires, varieties that show incompatibility on Quince. Two of these rootstocks were incompatible with these varieties in the nursery and eventually only 13 were considered fit to plant out in the trial. Mr. Hoblyn called attention to 21-year old trees on three selections, C1, C2 and C8, showing a range of size from very large to small. In the early years C8 promised to be precocious but at 13 years the vigorous C2 had cropped two and a half times as much as C8, and in recent years the difference has been even greater. The smaller trees present an unthrifty appearance and crop poorly and are regarded as uncongenial combinations if not actually incompatible. A further series of pear seedlings are now under trial.

Wrong use of quince stocks

Miss Dorothy Wilson referred to the wastage resulting from the wrong use of Quince rootstocks, illustrating her point by the behaviour of Conference on six Quinces. Trees on Quinces A, B and C were still surviving and cropping well after 30 years but all those on Quince F, 13 on G and 4 on D, died within two years. These were replaced by trees on the same stocks and again many more died and were finally replaced by trees on one of the more reliable Quinces. The search for better stocks was going on and something useful may come out of the new pear rootstock trial recently planted.

Photos: East Malling Research Station

Mechanical harvesting of Phalaris tuberosa—a pasture improvement grass which has trebled the carrying capacity of sheep and cattle lands

Mechanisation of Australia's Primary Industry

The move towards power farming in Australia is steadily gaining impetus, and now some 19,000 tractors are absorbed annually. Written by a member of the Farm Mechanisation Branch of Australia's Department of Commerce and Agriculture, this article summarises the present position, with emphasis on the influence that the United States has had on Australian trends and developments.

MANY patents for combines appeared between 1840 and 1890, and Australia played a leading part in developments, but the handicap of the early inventors was so great in having both to sell a new machine and at the same time introduce a revolutionary harvesting method opposed to all the dictates of time-honoured custom that it was not until 1890 that the grain-harvesting combine became a standard farm machine.

This experience is a somewhat forceful reminder that farm mechanisation development is related to agricultural development. The real problems are found not so much in engineering design as in the adjustment of conventional agricultural practices to a revolutionary change. Moreover, in agriculture established customs die hard.

In the U.S.A. in recent years the pressure of rural labour shortage and the high cost of paid labour has not only given a great accelaration to mechanisation, but has also influenced a change of mind which, in itself, has speeded development. For in the U.S.A. there is an increasing tendency to grow the crop to suit the machine as much as to design the machine to meet an established pattern of the crop. The Australian farmer knows only too well the urge towards mechanisation which so many of his 20th-century economic difficulties give him. What is not realised so well is that crops and crop practices will, in many cases, have to be adjusted to the needs of mechanisation if the mechanical approach to farm problems is to receive full rein.

Mechanical harvesting

Competition for manpower from secondary industry has dried up many of the pools of seasonal labour and has given an impetus towards the development of mechanical aids for harvesting those crops which previously had resisted mechanisation. There was often a social problem involved in this casual labour force, and for this, if for no other reason, it is unlikely to return to its former strength.

In the meantime, there is an urge in many directions towards mechanical harvesting. This is seen in the potato- and onion-producing industries in Australia, where the potato digger is now well established and where there is interest in, but not yet significant commercial use of, potato harvesters.

The laborious work of picking hops has been a challenge to mechanical invention for half a century, but the sensitivity to damage in ' unthinking hands '—by which a wrench or a shake can cause the vital hop resin or lupulin to fall from the hop cones like pollen from a flower and to be lost—has long resisted mechanical harvesting. Even so, the hop industries of the U.S.A., the U.K. and Australia to a lesser degree, are mechanically harvested.

Sugar cane, cotton and hops

There are significant developments in mechanical harvesting of sugar cane in Queensland and Northern New South Wales. Cane harvesting is divided into two main phases, cutting and loading. Both present many difficulties in mechanical handling, but the main problem is reminiscent of the early tribulations of the wheat combine in that a revolutionary change of agricultural practice has to be accepted as well as new machines. A short cut could probably be effected by some changes in the methods of cane cultivators and in the organisation of cane supplies to the crushing mills. At present too much is being asked from the agricultural engineer and

too little being done towards simplifying his problems.

Cotton harvesting is a recent development in Australia. There have been two main types of cotton pickers developed in the U.S.A., the selective picker and the snap picker. The selective picker spears each individual lock of cotton and introduces a minimum of foreign matter into the pick. This is an ingenious and complex machine which has been tested in Australia with good results. The basic principle is that of a series of spindles or needles mounted on revolving drums.

The snap cotton picker has not been tested in Australia. It is a simpler and cheaper machine which operates like a corn picker in stripping off the bolls.

A missing link in the chain of development is mechanical picking of orchard fruits. In the United Kingdom a prototype pneumatic machine has been designed for hop picking which may be the precursor of a significant mechanical aid in horticulture, even though the original prototype may not prove successful. The basic principles of the machine are the employment of hand-directed flexible tubes, a rotary cutter at the mouth of the tube and a suction delivery down the tube to a suitable container.

Aircraft

The specialised use of the aeroplane in agriculture has been developed to a greater extent in the United States of America, but there seems little doubt that it is one of the significant developments in mechanical application in Australia. Commercial enterprise is already providing services on a limited scale. At present the work is mainly confined to low-volume pesticide spraying in such crops as linseed, lucerne and peas, and distributing fertiliser as top-dressing for hill pastures.

The Tiger Moth is the standard aircraft and, although this plane is economical and has a low land speed for operation from farmers' paddocks, it has a payload of only some 300 lb., which greatly limits its scope.

In the U.S.A. aircraft have been specially modified for agricultural work and payloads of from 700 lb. to 1,500 lb. are obtained from planes which have the safety, low landing speeds and manoeuvrability required, but even in the more highly developed industry of the U.S.A. the great bulk of the operations is carried out by small aircraft of the fixed wing type. Rotary wing aircraft are used to some extent and have a big advantage in payload and economy.

Low volume spraying

The rapid advances in agricultural chemistry, arising from recent research in this, provided highly lethal pesticides such as DDT and the hormone-like weed-killers 2-4D and 2-4-5T. The minute quantities sufficient for the 'kill' made possible the great advance in low-volume spraying which has become one of the most significant new techniques in farm mechanisation.

Applications of toxic fluids are now down to as low as one gallon per acre, and to meet this a wide range of equipment has been developed, from the machine which produces a fog to air-blast aerosol equipment. The field of development is wide and progress is rapid. Practically all types of pre-war spraying equipment are outmoded.

Beaufreighters (converted Beaufighters) roar over a locust-ridden paddock in Victoria, spraying a solution of gammexane and diesel oil

Fodder conservation

Fodder conservation is now recognised in Australia as one of the keystones of a sound agriculture. Mechanical methods in hay-making and silage conservation have kept pace with the need for fodder reserves and have received considerable impetus from farm labour shortages. The pick-up hay baler, the power-mower and the side-delivery rake have enabled a hay crop or pasture hay to be cut, cured, windrowed, picked up and baled mechanically.

The speed with which the work can be done has enabled the pasture or field crop to be harvested nearer to the ideal stage of maximum nutrient, and the quick curing and baling away to storage has minimised nutrient losses from exposure to the sun, from leaching, or from mould resulting from rain.

The forage harvester, in its several forms, is a recent development which in part parallels the pick-up hay baling system. The forage harvester, in its best-known form, picks up a mown and windrowed green crop, chops the fodder and blows it into a wagon moving alongside. The fodder can subsequently be delivered (blown, if necessary) to either a below- or above-ground silo or to a stack. In the stack it would be stored and handled in the same way as hay. The forage harvester fits into fodder conservation developments by enabling green crops or pastures to be harvested for storage at a stage of high nutrient value.

Both the pick-up hay baler and the forage harvester make a major contribution to the quality of the conserved fodder as well as relieving labour shortages and reducing costs.

Improvements in the future may come from equipment or methods which speed up the curing process and further reduce wastage from exposure to sun and rain, or which combine individual operations. Thus there are coming into use machines which speed up drying by crushing the plant stalks between rollers and others which combine the process of mowing and windrowing.

Soil conservation

New conceptions of soil conservation, and the keener perception of the need to protect soil fertility have given new techniques to the cultivation of land which cannot always be handled satisfactorily by equipment evolved to meet older methods. The technique of having a protective cover of vegetative matter on bare fallow, or on land prepared for sowing, creates problems in the use of standard implements. The crop stubble or residue used to give the

cover obstructs a cultivator or a drill and cannot be retained on the surface by a mouldboard plough. Further, it is now realised that excessive pulverisation of the soil occurs under some conditions, particularly with high-speed working, and results in loss of topsoil from wind blowing.

There has been in recent years a marked swing towards disc implements as a partial approach to the new techniques, and in the U.S.A. and Canada a wide range of new implement types has been evolved. There are the sub-surface tillers, the harrow-ploughs (one-way discers), rotary hoes and rod-weeders. Some of these, at least, will eventually find a permanent place in Australia's farm mechanisation.

Mechnical and chemical weeding

A long-standing problem has been the intricate, laborious and expensive process of weeding many intensive or semi-intensive crops. Inter-row cultivation had been well developed mechanically, but there was still the problem of weeding between the plants.

A new field of development may open up from two directions. Chemical weed-killers, toxic to the weeds but not the crop, and applied by low-volume spraying, will probably provide one avenue. Pre-emergence spraying can give considerable assistance. The other may come from the use of a gas flame to scorch the weeds around relatively woody stemmed young plants. Flame weeders developed in the U.S.A. use propane or butane gas, but in Australia at present kerosene would have to be used.

Tractors

The development for the farm of tractor power, stationary internal combustion engines and electricity supply is a study in itself and is touched upon only lightly here. Australia has had a virtual revolution in power farming in the last decade and the number of farm tractors has risen from some 41,000 in 1938 to approximately 87,000 in 1949. At present the steady demand for tractors of all types ranges round 19,000 a year. Last year some 25,000 units were probably absorbed, but there were the remains of a war-time back-log in supply included in this. High as these figures may seem, it is nevertheless true that the move towards power farming in Australia, rapid as it has been, is yet very considerably less than that in the United Kingdom, where the tractor force has been more than trebled in the last decade.

(Abbreviated from the 'Commonwealth of Australia Quarterly Review of Agricultural Economics,' **3** (4), p. 166-171.)

Photos: Australian News and Information Bureau

A green crop loader at work on a young pea crop in New South Wales. The machine belongs to one of Australia's co-operative machinery pools

The Chelsea Show

The annual show of the Royal Horticultural Society, held in the grounds of Chelsea's Royal Hospital, is always an event to which gardeners, professional and amateur alike, look forward year after year. At Chelsea they forgather to admire a range of flowers, fruit and vegetables *par excellence*, and this year the magnificent display seemed larger and more colourful than ever. Nine great marquees housed over 100 flower exhibits, besides those of flowering shrubs and trees outside. There were, as well, 14 exhibits of different types of garden ranging from moorland and woodland to the more formal examples.

The scientific section aroused keen interest among many visitors, and exhibitors in this section included the British Orchid Growers' Association, Long Ashton, East Malling and Cheshunt Research Stations, Rothamsted Experiment Station and the University of Reading Horticultural Department.

The East Malling exhibit covered research on spring frost damage by the use of continuous water sprinkling to prevent damage to fruit blossom. The seriousness of chrysanthemum mosaic disease and virus diseases of other glass-house crops was shown by means of photos and 'live' exhibits in the Cheshunt display. Long Ashton's subject was mineral deficiencies (particularly copper and zinc) in fruit trees and soil determinations of these elements. Reading University showed a technique used for studies on the nutritional requirements of plants involving hydroponics; nutritional deficiencies in tomatoes and chrysanthemums were illustrated. Rothamsted's exhibit was on honey bees and included an observation hive.

Every horticultural sundry and accessory that the gardener or smallholder could want was to be seen among the many trade stands at the show.

Small power machines and tractors were exhibited by, among others, Dashwood Engineering Ltd., Ransomes, Sims & Jefferies Ltd., Rotary Hoes Ltd. and Vivian Loyd & Co. Many firms had stands displaying a wide range of insecticides, fungicides, weedkillers and fumigants, including the Murphy Chemical Co. and Plant Protection Ltd.; the latter's exhibit illustrated the cultivation of the rose and control of its pests and diseases.

WORLD CROPS

OUR NEXT ISSUE will include an article by C. W. S. Hartley, of the Federation of Malaya Department of Agriculture, on **Cocoa Investigations** which are being carried out in that country. D. P. Hopkins writes on **salt as a fertiliser.** Also there will be an article on **the world tea industry** and Part II of G. T. Bray's aricle on **tung oil.** A report of the **Fernhurst Conference on Crop Protection** will be given and we also hope to include a description of the **1951 Royal Show.** Besides these, other articles will appear and the usual regular features.

CORRESPONDENCE

Tropical Grasses

TO THE EDITOR

Dear Sir,

Mr. Shacklady's article in your March 1951 number on the feeding value of tropical grasses is of considerable importance, but I think that he may have been misled by the figures he cites.

In his article, after examining the possibilities of certain tropical grasses for the production of proteins, he concludes, 'Temperate countries can, and do, produce a part of their requirements for balanced concentrates from their own grass; the tropical farmer on the other hand does not, cannot and never will.' But Mr. Shacklady bases his argument on crop analyses given by Schneider, without stating the stage of growth of the grasses examined. It seems from the figures quoted that Schneider was referring to mature or nearly mature grasses, and that Mr. Shacklady is therefore falling unwittingly into the error, so common before the feeding value of young grass had been fully investigated, of evaluating grass at its 'hay' stage.

The following table shows that certain tropical grasses can have very much higher protein values than Mr. Shacklady assigns to them. The analyses were done on grass from nursery plots which had all had about 100 lb. per acre of sulphate of ammonia, were in vigorous growth and were cut at the 'grass drying stage'—that is, preflowering. The height varied with the species, but they were all cut at the height of a mower blade and all were leafy. The grasses were then dried in a Slade-Curran grass drier (believed to be the only drier in the southern hemisphere). The resulting product would have passed for artifically dried grass from Britain.

	Crude protein % (100% *D.M.*)	*Crude fibre* % (100% *D.M.*)
Phalaris tuberosa ..	30.8	22.8
Kikuyu	22.3	23.1
Setaria Kazangula ..	22.3	25.1
Star Grass No. 4 ..	18.1	27.1
Upright *Paspalum* ..	17.7	32.0
Panicum Makarakari	16.8	28.3
African Foxtail ..	16.6	30.8
Setaria Bua River ..	15.7	27.1
Guinea Grass ..	15.1	30.8

Apart from *Phalaris tuberosa*, all these are true tropical grasses. The figures appear to show that there *is* a good possibility of using such grasses as a source of protein, possibly by artificial drying, if economic, as is done with temperate grasses in the U.K. It would appear, however, that if grass is to be used for anything but roughage it must be well looked after, growing fast and cut young. But whether further experience shows that tropical grasses can be used for protein production or not, it should not be forgotten that, where lucerne can be grown, a most satisfactory protein concentrate can be obtained, provided that the crop be dried so as to retain the leaf. Artificial drying opens up enormous possibilities for the tropics and sub-tropics in this direction.

Yours faithfully,

RICHARD P. POLLITT

Makalanga, Mazoe,
S. Rhodesia. *May* 2, 1951.

Mr. Shacklady replies as follows:

I do not, of course, dispute the figures which Major Pollitt has given, but I submit that they are not very enlightening by themselves. There has never been any doubt that it was possible to obtain material of high protein content from tropical grasses, but there is considerable doubt as to whether the large scale production of high quality dried green fodder from these grasses is either practicable or economic.

In order to assess the practicability of any such projects one must consider (a) the period for which these high values persist, (b) the moisture content of the fresh material in this period and (c) the yield of dry matter per acre. There is no indication of any of these factors in Major Pollitt's letter. Their importance is obvious, as, unless the high protein level is maintained for a reasonable time, there is a very definite limit to the amount that is worth harvesting.

As the final output is measured in terms of 'dry' matter, initial moisture content is of prime importance. It affects directly the yield of dry material which will be obtained from a given weight of the fresh crop and also the amount of fuel required to evaporate the moisture present. Finally, the yield, as such, must be considered. It is of no use to grow a high protein crop unless the ordinary harvesting machinery can deal with it at this stage of growth and unless the yield repays the effort of harvesting.

Of the grasses Major Pollitt has enumerated, only the first four or, possibly, five can compare with temperate grasses in the all leaf stage. Paterson's experience in Trinidad would suggest that at this stage the moisture content of the grasses would be over 80%. This means that, in order to obtain reasonable quantities of dried material in the period of high protein content, a very large acreage would have to be covered, and so, even if wilting were practised, a large-capacity drier would be needed to deal with all the material. We are ourselves using a drier capable of evaporating 6 to 8 tons of water per hour and even so find it necessary to wilt material when it is much above 75% in moisture, so as not to have surplus green material. Due to respiratory and fermentation losses—mainly carbohydrate and some pro vitamins—there is a limit to which wilting can be carried with safety.

It is also true that experimental plot figures can be dangerously misleading when applied to large acreage prediction. I feel rather strongly about this, as one of our major problems has been to correlate experimental plot results with figures actually obtained under operating conditions.

I must, in self-defence, point out that in my table of nutritive values of tropical grasses I have indicated by means of the suffixes (a), (b) and (c) the stage of growth to which the observations refer. I am only too well aware of the importance of this factor, being part-author of a *Guide to the Grading and Feeding of Silage*, in which we have advocated its use as one of the principal methods of grading. This theme is also stressed in a joint paper with P. Newbound at present in the press, a copy of which I shall be happy to send to Major Pollitt.

In conclusion, may I say that the fact of having obtained some high protein material from experimental plots of tropical grasses does not, *per se*, prove that the large-scale production of concentrated fodder from these grasses is an economic proposition. At the same time, I should be delighted to be proved wrong in my opinion that the tropics will not produce grass concentrates.

With Major Pollitt's remarks on lucerne I am in entire agreement. My omission of this from the list was because, in spite of its origins, we have come to regard lucerne as no longer a true tropical plant. I think that irrigated lucerne would, when conserved, go a long way towards supplying at least some farmers with a concentrated fodder in the true sense of the word.

C. A. SHACKLADY

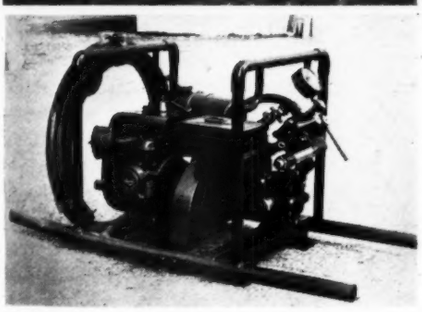
May 17, 1951.

Letters to the Editor

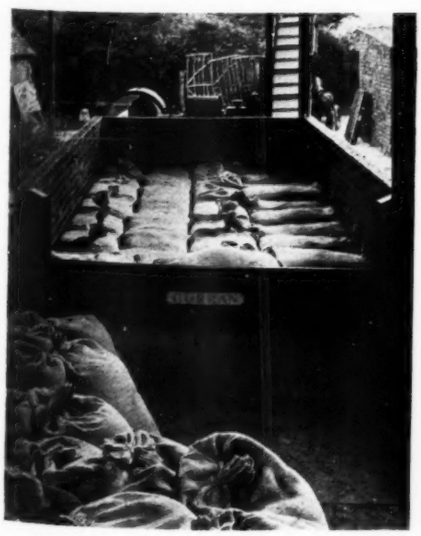
The Editor is always willing to consider letters, written on subjects of interest to readers of WORLD CROPS, for inclusion in the Journal.

FARM MACHINERY

Robot seed planter with fertiliser distributor made by Transplanters Ltd. *(See overleaf)*



Top, Allman 'Genimec' spray rig, fitted with master control. Bottom, Allman portable spray unit



Slade-Curran crop drier drying grain in sacks

Royal Show Preview

The machinery lines at the Royal Agricultural Show are always a centre of attraction and this year at Cambridge they promise to be bigger and more varied than ever. The following pages show some details of the exhibits appearing at this year's show.

A Century of Farm Implements

Farm implements and machines about 100 years old, some of which are still in use today, will be seen in an historical display to be staged by the R.A.S.E. at this year's Royal Show.

The Great Exhibition of 1851 at the Crystal Palace coincided with the dawn of a new era of mechanised farming. Then, although the reaping hook and the flail were the common tools of the harvest, implements such as the new reaping machines of Bell, McCormick and Hussey were arousing great interest.

In 1851 the R.A.S.E. held the machinery section of its annual show at the Crystal Palace, and a farm cart exhibited there, which is still in use on a farm in Northamptonshire, will be included in the historical display at Cambridge this year.

The display will show the common farm tools of 100 years ago in company with the machines that were beginning to replace them. A seed drill will stand beside a seedlip and dibbler; a plough made entirely of wood beside an improved iron plough which was in use on a Hertfordshire farm until 1939; a replica of the original McCormick reaper will contrast with the sickle and fagging stick.

Other exhibits will include an early portable steam engine which was pulled from place to place by horses, a two horse wood-framed mower and a winnower, built in 1853, which has recently been converted to engine drive and after the Show will be used by the owner for cleaning grain from this year's harvest.

The exhibition will be divided into six parts, illustrating ploughing, cultivating, seeding, harvesting, threshing and the use of barn machinery.

Royal Show—Silver Medal Entries

Accepted entries for the 1951 R.A.S.E. Silver Medal Award for new implements total 19, from 17 manufacturers. Three of the machines were shown last year and deferred by the judges for consideration this year.

A number of the entries are connected with forage harvesting and hay making, including a silage combine, P.C.L. hay maker, side-delivery rake and a crop drier. Harvesting equipment includes a sugar beet harvester, mobile hop-picking machine, pea cutter and swather and a sugar beet topper and conveyor. Two mounted reversible ploughs have been entered, also a horticultural tractor, a one-man rear-steerage hoe and a half-track conversion, covering cultivation implements. A milk cooler and hammer mill are the only two stationary pieces of equipment that have been entered. Other entries are a combined seed drill and fertiliser distributor, potato haulm cutter, 'Roto Flail' haulm disintegrator and a radio locating device for ferrets.

2 cwt./hr. Crop Drier

An oil-fired model of the Slade-Curran crop drier will be in operation on stand 466, while a semi-producer type will be demonstrated on the Gas Council Model Farm, stand 402. Designed by Dr. R. E. Slade, winner of the recent Royal Society of Arts prize for a means of promoting the production or the economic utilisation of food in Britain, the drier is intended to assist the small and medium farmer to produce his own winter feed. It is claimed to give an output of 2 cwt./hr. of dried grass and to be suitable for drying most crops. It is manufactured and marketed by the Process Plant Division of Edward Curran Engineering Ltd.

Two New Sprayers

In addition to their standard range of dusting and wet-spraying machines, Messrs. E. Allman & Co. will be exhibiting two new models on their stand (No. 366) at the Royal. One which is expected to attract attention, both for overseas and home buyers, is the 'Genimec' spray rig. This new sprayer uses the chemical barrel or any standard 40- to 45-gal. barrel as the liquid container, thus avoiding the expense of a special tank. From the overseas buyer's point of view, this makes a great saving in freight charges. The 'Genimec' spray rig can be supplied to fit the hydraulic lift of most makes of tractors.

Another new machine is the Allman portable spray unit, which can be carried as a stretcher; it is also fitted with brackets to bolt on to the floor of any type of vehicle. Powered by a Villiers Mark 12 four-stroke engine, the Allman bronze gear pump has a capacity of 680 gal. per hour at zero pressure and 480 gal. per hour at 100 lb/sq.in. A 'Genimec' finger-tip control fitted as standard equipment regulates pressure over the complete range of the pump and also provides boom selection and automatic agitation. The net weight, complete with suction by-pass hoses, is 112 lb. (*See photos previous page*).

Ransomes' Exhibits

On the main Ransomes, Sims and Jefferies stand (No. 330) at the Royal Show this year will be seen a comprehensive selection of agricultural equipment, including, in the export section, the 'Commando' four-furrow disc plough, multiple-furrow share ploughs, a 30-in. maize sheller and the M.G.5 tractor with bulldozer. A wide variety of ploughs will be exhibited, including the Ford-Ransome joint products. The two-furrow mounted reversible plough has been entered for the R.A.S.E. Silver Medal Competition.

Besides these, there will be a range of other cultivation implements, spraying machinery, a threshing machine and a model crop drier in motion.

1-, 2-, 3-, 4-Furrow Mounted Ploughs

The Turner Manufacturing Co. will exhibit their 'Yeoman of England' diesel tractor on Stand 284 at the Royal, together with Yeoman one-, two-, three- and four-furrow mounted ploughs. Visitors will also see their hydraulic loader, mounted sawbench and mid-mounted mower, all specially adapted for the Yeoman tractor.

British Made Disc Plough

After nearly two years of research and development, and field testing in five different countries, the Ford Motor Co. have produced a mounted disc plough to meet the needs of farmers in countries where this system of tillage is normal practice. The Fordson disc plough is available in three models, as follows: three-furrow convertible to two-furrow for 10-in. or 12-in. wide ploughing, two-furrow (normal clearance between discs) for 10-in. or 12-in. wide ploughing and two-furrow (extra clearance between discs) for 10-in. or 12-in. wide ploughing. The discs are made of specially hardened steel and are 26 in. in diameter, running on taper roller bearings sealed against grit or dust.

Garden Tractor and Attachments

A range of attachment for the light (140 lb.) one-wheel Colwood garden tractor will be seen on the stand of Dashwood Engineering Ltd. The engine is a 1.2 h.p. machine with two forward speeds and can be adapted for a range of operations including cultivating, lawn mowing, spraying and water pumping, seed and fertiliser distributing, etc.

Made by the same firm is the Whitwood seed drill, a hand machine for the small grower or nurseryman, which can also be used with the 'Colwood' garden tractor, with special attachments. The seed box has a capacity of three pints and drills can be set up to a width of 24 in. The Whitwood can be adapted for spreading artificial fertilisers.

Planters and Transplanters

A comprehensive range of transplanters and potato planters will be on show at the Transplanters (Robot) Ltd. stand, including a new machine, the Robot seed planter with fertiliser distribution. Three transplanters will be exhibited; a unit type with watering attachment, for use with all the popular power-lift tool bars, a mechanical machine, trailer or power-lift model, with automatic watering and ridge planting attachments and a large transplanter for planting sisal, sugar cane, saplings, etc.

Six two- and three-row potato planters will be on view including trailer and power-lift models with fertiliser distributors, which are optional attachments.

The new seed planter is described as being suitable for single or grouped seeding of maize, groundnuts, sunflower, sorghum, peas, beans, sugar beet and other seeds of similar size. The automatic fertiliser distributor places granular fertiliser in a band about 2 in. away from the seed. Dressing per acre can be adjusted up to 15 cwt. and row spacing is from 18 in. upwards. The machine is available for use with hydraulic power-lift or as a trailer model.

Other Transplanter machines to be exhibited are a single-row sugar-beet harvester, a root cleaner and elevator and a post-hole digger.

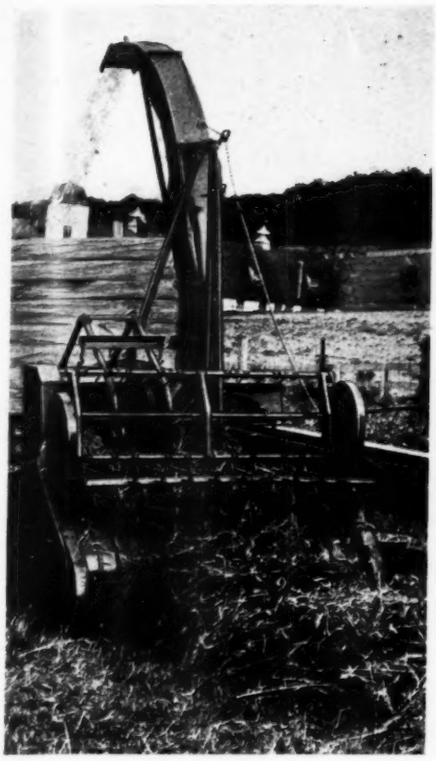
Rotational Grazing

The well-known Wolseley electric fencer will be the principal item on show at the Wolseley Sheep Shearing Machine Co.'s stand. Since the introduction of this type of fence many improvements have been made, one of the main ones being the simplification of the fence posts right down to $\frac{1}{4}$ in. wire manufacture with strong end-tripods at either end of the fence. Provided these end posts are well anchored, the light steel posts are quite sufficient for the job. The latest insulator, the 'tent,' is made of unbreakable plastic and satisfies the special conditions required for strip grazing and kale folding, allowing speedy attachment and removal of the wire.

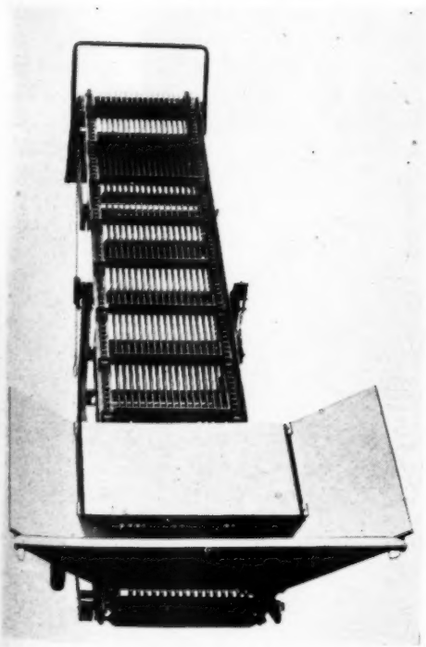
Also shown will be the 'Radio Ferret,' an adaptation of a war-time radio detection development for minimising the time lost in digging out a ferret which has gone to ground. This device has been entered for the R.A.S.E. silver medal competition.

A new Wolseley elevator is the Model 'Twelve,' fitted with grille rails to prevent soil clogging on the ramp when loading sugar beet and similar root crops. Soil falls through the open bed and roots are delivered in a much cleaner condition. In

The Fordson mounted three-furrow disc plough on land reclamation work near Port Elizabeth, South Africa



The new Holland forage harvester is now made with a new windrow pick-up with spring tooth reel and pick-up fingers, similar to the N.H. baler pick-up. The new pick-up, available for the first time this season, can be attached to self-powered or power take-off models



The Wolseley model 12 mobile elevator, fitted with grille rails, is designed to prevent soil clogging on the ramp when loading sugar beet and other roots. This model is fitted with a large hopper

A number of demonstrations of Rotavators has been given in India and Pakistan recently, under the supervision of Mr. R. Ingram, senior representative of Rotary Hoes Ltd. The above picture was taken at Serampore, near Calcutta, and shows the 'Gem' being demonstrated in wet padi

all other respects this machine is the same as the Standard Model 'Twelve.' The height of delivery is 9 to 12 ft. and the price £186 3s. 6d., plus £22 for the large hopper.

Dusters and Sprayers

Cooper, Pegler & Co. announce that on stand 409 will be shown most of their range of spraying and dusting machinery, including pneumatic knapsack sprayers and most accessories for applying all types of washes and dusts. Their range includes products designed to handle lime, whitewash, creosote, disinfectants and anti-malarial oils.

Successful Demonstrations in India and Pakistan

We are informed that a number of demonstrations of Howard Rotavators are taking place in India and Pakistan under the supervision of Mr. R. Ingram, Senior Representative of Rotary Hoes Ltd. According to the Director of Agriculture of the Government of Eastern Bengal, tests carried out with the Rotavator 'Gem' have shown that this machine will cultivate three bighas of land in five and a half hours (three bighas are the equivalent of one acre). To cultivate the same area it would take three pairs of bullocks eight hours.

It is reported that the mechanisation of farms in Eastern Bengal is a matter of increasing urgency. Many cattle are being killed for food and as a result the number of draught animals is decreasing. The demonstrations should help to alleviate this situation.

IH Diesels Produced in Restored German Works

Realising that a tractor with a petrol engine was not acceptable to the agricultural trade of Western Germany, officials of International Harvester's subsidiary factory at Neuss decided two years ago that a change over to diesel power was necessary. Now a new 25-h.p. McCormick International Farmall diesel tractor is on the market, powered by a four-cylinder, 1,650-r.p.m. diesel engine. It has a 78-in. wheelbase, a tread adjustable from 50 to 64 in. and weight of 3,750 lb. Power take-off and belt pulley, the latter as special equipment, are other sources of power besides the drawbar. Equipment to work with the Farmall D.F. includes a two-bottom, two-way direct-connected plough and two-row mounted potato cultivator, as well as a power-driven mower and grain binder manufactured at Neuss.

Neuss was a frequent target for Allied artillery and air bombardment. More than 500 bombs struck the works and when the war ended in 1945 about 80% of the plant, including the grey iron foundry, was destroyed. Mountains of rubble were cleared away by hand; there was no machinery available. Steel roof trusses which were twisted and bent by explosion and fire had to be pried apart, straightened piece by piece and then reriveted. Machine tools, picked out of basements from under tons of rubble and often in water, were cleaned, overhauled and in some cases motorised.

By spring of 1947 a small amount of grey iron was made in the malleable foundry.

With this and material supplied by the military government (the plant was under control of British occupation officials), some mowers, binders and a few other implements were produced. Manufacture of service parts was receiving attention.

In an unheated plant, without a roof or side walls in many places, more than 1,300 men who lacked adequate food and clothing were working to build machines that would assist in production of food.

When Mr. Fowler McCormick, chairman of the board of the parent company, visited Neuss in 1950 he found an amazing restoration of the factory; accomplished at an expense of 8,000,000 marks, there was little evidence of former destruction.

At that time he and other officials from Chicago examined the pre-production models of the Farmall D.F. tractor with its diesel engine.

German-made International Harvester Farmall D.F. pulling a two-bottom direct-connected mouldboard plough

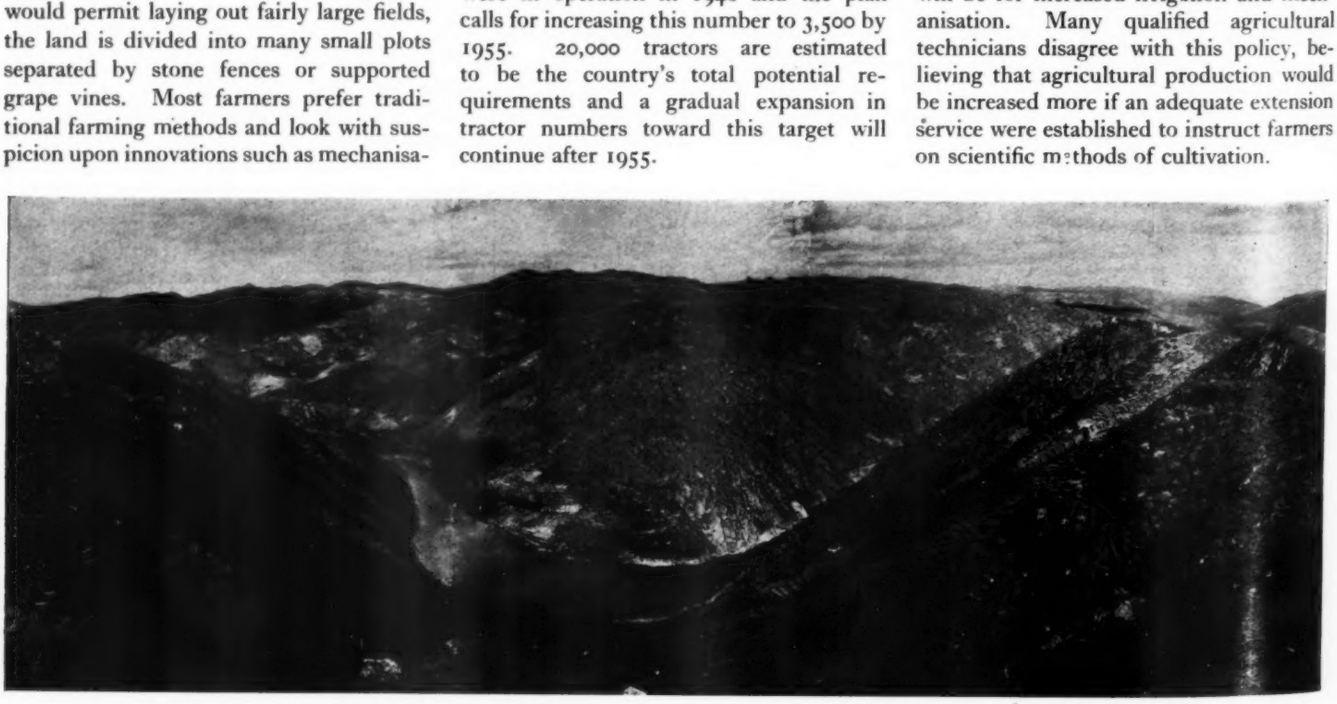
Farm Mechanisation Difficult in Portugal

Tractors are used on only 2 to 3% of cultivated land in Portugal. Most tillable land is not suitable for tractors and harvesting machinery. The southern Alentejo plains is the region best adapted for their use. Northern Portugal and the Algarve areas are hilly and cultivated areas are interrupted by many natural obstacles. Tractor operations are difficult in these regions because where the topography would permit laying out fairly large fields, the land is divided into many small plots separated by stone fences or supported grape vines. Most farmers prefer traditional farming methods and look with suspicion upon innovations such as mechanisation. Other factors discouraging the use of machinery are the general availability of animal power, low labour costs, high fuel prices, machinery maintenance and repair problems.

The Government agricultural service has prepared an ambitious plan for increasing mechanical power and farm machinery on Portuguese farms, in spite of obstacles to such a project. About 1,200 farm tractors were in operation in 1948 and the plan calls for increasing this number to 3,500 by 1955. 20,000 tractors are estimated to be the country's total potential requirements and a gradual expansion in tractor numbers toward this target will continue after 1955.

To facilitate its mechanisation plan, the Government hopes to establish a national industry for farm machinery manufacture. Only hand tools and ploughs are manufactured now and the production of agricultural machinery will probably be severely restricted because Portugal lacks a domestic metallurgical industry.

It seems likely that the major portion of Portuguese expenditures for agriculture will be for increased irrigation and mechanisation. Many qualified agricultural technicians disagree with this policy, believing that agricultural production would be increased more if an adequate extension service were established to instruct farmers on scientific methods of cultivation.



The mountainous nature of much of Portugal's country does not lend itself to mechanised farming. Picture shows the famous Douro River valley in the north, where grow the vines that produce port wine. It is only wine grown in this area which is truly entitled to the appellation 'port wine' *Photo. Portuguese Information Office*

RECENT NEWS AND DEVELOPMENTS

Anhydrous Ammonia Successfully Used on Rice

SINCE 1947, when it became available for widespread distribution, anhydrous ammonia has steadily gained in popularity as a nitrogenous fertiliser in the United States. From 200,000 acres treated in the Mississippi delta in 1947, its use has spread through 25 states and in 1949 between 1,000,000 and 1,500,000 acres were treated, including crops ranging from maize to sugar beet. Today 80% of the Louisiana sugar-cane crop is fertilised with anhydrous ammonia.

Experiments on rice

The possibility of using it on rice was inevitably envisaged and in 1948 experiments were started at the Rice Branch Experiment Station, Arkansas, an account of which appeared in *The Rice Journal* (April 1951, **54** (4)) and from which these notes are taken. Anhydrous ammonia was compared with ammonium nitrate, the two materials being applied at such rates as to supply 50 lb. per acre of the element nitrogen. Ammonium nitrate was broadcast on the dry soil at the same time as anhydrous ammonia, which was injected into the soil 5 to 6 in. deep and in rows 11 in. apart; this was done five days before planting. Yields of rice in bushels per acre were as follows: from the control area, which received no nitrogen, 64.2; from the plot receiving ammonium nitrate, 72.7; from the plot receiving anhydrous ammonia, 79.9. This preliminary experiment indicated that anhydrous ammonia was a good source of nitrogen.

Further tests conducted the following year, using a different variety of rice, confirmed the previous findings and anhydrous ammonia may now be said to be a reliable and cheap nitrogenous fertiliser for the crop, although further experiments are being carried out.

Utilising irrigation water

A more economical method of applying anhydrous ammonia than by using an injecting machine is bubbling it into the irrigation water. As it is a gas at normal temperature it has to be kept in a pressure tank having a varying pressure of from 75 to 197 lb./sq.in., depending on the outdoor temperature. Ammonia weighs 5 lb. per gal. and is 82% nitrogen, therefore each gal. contains 4.1 lb. of nitrogen and 1 ton contains 1,640 lb. of nitrogen. A 1,000-gal. tank contains sufficient ammonia to fertilise 80 acres at a rate of 40 lb. of nitrogen per acre by bubbling it into the irrigation water as the field is flooded.

This method, however, does involve the problem of even distribution; it is thought that this can only be obtained over an area of 75 to 100 acres when only one point of application is used. Large fields of 300 to 1,200 acres, as do occur in certain rice-growing areas of America, either have to have several water entries or a system of lateral cuts through or around them so that water can be opened into the individual cuts.

An important point is that distribution will be excellent on any acreage regardless of size, provided it can be watered within 48 hours.

Chemical changes

When ammonia is added to irrigation water, the majority of it combines with the water to form ammonium hydroxide; the remainder combines with the minerals in the water to form various compounds of ammonia. In either of these combinations, it is distributed over the soil by the water, is readily absorbed, combining with the clay and organic matter in the soil, and is immediately available for plant use. There is practically no loss by leaching, as it is absorbed by the clay complex. The ammonium nitrogen is, however, immediately available for use by the plants, and that which is not used in that form is converted into nitrate nitrogen over a period of four to six weeks.

Other advantages of the use of ammonia are that it increases the solubility of other plant foods by base exchange, does not reduce the soil's bacterial population, nor does it have any bad effect on soil tilth, water penetration or chemical composition.

Future prospects

Considerably more experimental work will need to be done before the application of ammonia to rice is accepted as general practice, but in the southern states of America at any rate, it is felt that, from experiences and observations, it is probably as good or a better fertiliser than ammonium nitrate.

Growers should not forget, however, that rice requires other foods besides nitrogen, although it is the one most required and, in many cases, the one most likely to be needed in the soil.

The American Hop Industry

Hops of commerce are the dried female flowers, or cones, of a perennial climbing vine. They reach market pressed into burlap-covered bales weighing approximately 200 lb. each.

The female flowers are an essential ingredient in the manufacture of fermented malt beverages and the soluble resins and volatile oils which they contain impart the characteristic flavour and aroma to the finished products. Substances derived from these resins are now being studied in the treatment of human tuberculosis.

The seeds in hops increase the weight but not brewing quality and the trade usually pays a premium for seedless varieties. Leaves and stems are undesirable and the price usually declines as the percentage of leaf and stem content of hops increase.

There is considerable variation in site, soil, climatic conditions and cultural practices in the U.S.A. in which hops are grown. In coastal sections of California Washington and Oregon, irrigation is the exception rather than the rule. The use of overhead rotary sprinkler irrigation systems, however, is increasing, particularly in Oregon. In inland areas, irrigation is essential.

Good, deep, well-drained soil is preferred. The land must be levelled before planting if it is to be irrigated by methods other than by overhead sprinkler. Poles placed at regular intervals support a heavy wire framework or trellis. The hop 'roots' or cuttings are planted by hand, commonly in rows 8 ft. apart to permit cross-cultivation. Wooden pegs are driven at each hill and twine is tied to the overhead trellis wires and fastened to each peg.

Tractors have largely replaced horses for ploughing, fertiliser distribution and cultivation. Even the annual grubbing or hoeing and pruning of crowns of well-established plants, usually a hand operation, can now be done by machine. Insecticides and fungicides, both dust and liquid, are applied by hand or power-driven ground sprayers and dusters, by aerosol generators or by aeroplanes.

Although harvesting is still a laborious hand operation in many yards, both portable and stationary picking machines are rapidly supplanting hand picking. The old-time drying process is being replaced by scientifically designed kilns which are practically automatic. Handling is being

minimised by the use of conveyor belts. In some yards electric motor-driven balers are being used, although the horse-operated capstan-like device is still common.

Disease is a major problem of the hop industry. Damage from downy mildew, red spider mites and the hop aphids is causing concern to both growers and dealers. Combatting these pests has raised production costs considerably, particularly in the Willamette Valley of Oregon.

American hops must be properly graded if they are to compete successfully with foreign-grown products. Chief physical quality requirements are that hops be free from leaves, stems and seeds, free from disease, relatively unshattered and properly dried.

(From *The Agricultural Situation*, U.S. Dept. of Agriculture.)

Portable type mechanical hop picker in the fields at Yakima County, Washington State

Photo: U.S.I.S.

Successful Use of Aldrin

Following last month's news of the locust outbreak in Persia, encouraging reports of one of the insecticides used—Aldrin—have been received. This insecticide was initally applied in semi-desert country south-east of Abadan. The locusts ranged from newly hatched nymphs to the third and four instar stages of development and a high kill of even the oldest nymphs was reported: 95% or even better within 24 to 48 hours, and feeding ceased within a matter of minutes after application of spray.

Observers noted especially large clumps of date palms so heavily covered with nymphs that they were bowed down with the weight. The spray aircraft came over releasing the Aldrin and within a few minutes the pests began to fall to the ground, the leaves returning to normal position.

In the first application, Aldrin was applied at the rate of 3 oz./acre, but was later cut back to 2 oz., which is the standard dosage recommended in the U.S.A.

Israel's Achievement

The number of agricultural settlements (apart from townships and agricultural suburbs) in Israel has increased from 277 to 531 since the State was formed three years ago, according to a report from the Office of the World Zionist Organisation in London. The area of land under cultivation today amounts to 2,800,000 dunums (approximately 933,000 acres), apart from 700,000 dunums cultivated by Arabs. This is a fourfold increase on the area cultivated three years ago.

Although still far from achieving self-sufficiency in food supplies, Israel can supply almost all her vegetable requirements and next year hopes to produce sufficient potatoes for the home market.

Radioisotope Tracers and the Utilisation of Phosphorus by Plants

THE use of radioisotope tracers for investigating the role of various elements in plant and animal nutrition is attracting much attention on both sides of the Atlantic, and in the U.S.A. particularly is it finding extended application. Readers may remember that the subject was discussed in a paper by Dr. R. Scott Russell in WORLD CROPS of October 1949. Since then considerable progress has been made, especially in connection with phosphorus.

The position in the U.S.A. has lately been reviewed by Dr. C. E. Waring in a recent issue of *Agricultural Chemicals*. Dr. Waring points out that utilisation of phosphatic fertiliser is currently not very efficient in that only about one-third of the available phosphates are used by the plants in the first year following application. Before this situation can be improved, it is first necessary to determine what happens to the native phosphate present in the soil and to that added as fertiliser. Past studies, depending on chemical analysis of plant tissue, were of little value in this respect since the analytical method did not distinguish between the two sources of phosphate. With the development of the tracer technique, radioisotopes of phosphorus may be incorporated in the applied phosphate and these ' tagged atoms ' followed throughout the growth cycle of the plant. Minute quantities of elements, beyond the scope of chemical analysis, may be detected by means of the ' tagged atom ' tracer method.

Studies of this nature conducted by the North Caroline Agricultural Experimental Station and the U.S. Department of Agriculture determined that there is a wide variation in the behaviour of certain crops towards utilisation of soil and applied phosphates. The potato plant derived as much as 60% of its phosphorus from fertiliser throughout the growing season. For corn and soya-beans the percentage of phosphorus derived from fertiliser was high initially, but decreased progressively during the growing season.

Possibly this may be explained by the fact that potatoes are a short season crop with a comparatively limited root system and consequently depend to a large extent on a concentrated supply of fertiliser phosphorus. Corn, on the other hand, is a long season crop with an extensive root system and, therefore, may utilise a large quantity of soil phosphate during later stages of growth. During the early stages of growth, however, corn utilises fertiliser phosphorus effectively. During the seedling stage of growth of corn and cotton it was found that only a small amount of phosphorus came from fertiliser. In this case it is believed that the roots had not yet reached the fertiliser and that the plant phosphorus was being supplied from that stored in the seed.

In general it was found that the plant uptake of phosphorus from fertiliser increased with quantity of fertiliser applied and was higher throughout the season in areas where soil phosphate was at a low level.

The outstanding result of radiophosphorus research so far is the convincing evidence that the crops under study—corn, tobacco, cotton, potatoes, beets—are able to utilise effectively the residual phosphorus from previous fertilisation much more than previously thought. This observation justifies the recommendation that the phosphorus fertility level of all soils should be raised through generous applications of phosphate fertilisers. Little, if any, of this applied phosphorus is lost by leaching; the loss through erosion of surface soil is considerably greater.

SHOWS AND MEETINGS

Ulster Farm and Factory Exhibition

The agricultural section of this exhibition provides the largest display devoted to agriculture at any of the Festival of Britain exhibitions in the United Kingdom and on June 1 it was opened by Her Majesty the Queen at Belfast. The exhibition will remain open until August 31.

Agriculture is the largest industry in Northern Ireland and in this exhibition it takes up about one-third of the indoors area and two-thirds of the open-air display.

The treatment here is such that both layman and farmer can get a clear picture of the great importance of the agricultural industry to the community as a whole and its remarkable growth within the last 100 years—and particularly within the last 25 years.

The section opens with a general introduction showing the importance of agriculture in relation to the other industries of Northern Ireland. (Although only one-twentieth of the size of the United Kingdom, Northern Ireland produces one-fourteenth of the total agricultural output.)

In historical treatment it shows the development of the land tenure system since the 1870s whereby the Northern Ireland agricultural community have become the owners of their land and not merely tenants. It illustrates the developments in agricultural education and, especially, the tremendous increase in output within the past 25 years of the various types of agricultural produce for which Northern Ireland is noted. These increases are illustrated in individual sections dealing with eggs, milk, fruit, oats, potatoes, agricultural machinery and livestock.

A complete farmyard and farmhouse dominate the open-air section. This is the ' Farm of the Future,' incorporating the best modern methods of layout and designed for the comfort and convenience of the farmer. The farmyard is so designed that the various ranges of buildings are capable of extention without unduly upsetting the ease of access to any particular section.

The farm will be in complete working order with milking cows producing Grade 'A' T.T. milk, live calves, poultry and pigs, as well as a complete range of the most mechanised equipment.

Farmhouse and yard are supplied with the latest electrical equipment for convenience and labour-saving. The buildings also present ideas in construction and finish which show that the farmyard of the future can be well lighted, well built and of a pleasant finish and yet represent the maximum economy in use of material. This farmyard will be a full-size working farmyard of the type that could be designed to suit any size of farm. It will be suggested that the housing at the exhibition is of a type suitable for the average 40-acre farm. The visitor may consider some of the ideas, not only in the farmyard, but even more so in the farmhouse, a trifle unorthodox. They show the ' theoretical ' possibilities in farmyard design, for the cost of construction, electrification and incorporation of all the gadgets would surely be prohibitive to the majority of farmers (the electrical installations cost around £4,500).

Royal Show News

Advance information of this year's Royal Show (to be held at Cambridge, July 3-6) promises a bigger and better display than ever before. Covering an area of 150 acres, over half of which will be taken up by more than 600 stands displaying the whole range of machinery, equipment and tools, the show will include parades of livestock, tractors and implements, horticultural and forestry displays, scientific and educational exhibits and many other attractions.

The main theme of the Ministry of Agriculture's exhibit, covering this year more than an acre, emphasises the need to give crops and livestock a good start for greater output. The outdoor plots will demonstrate: the manuring of a typical sequence of crops of four predominant soil types in East Anglia; seed dressing and control of weeds in cereals; labour-saving methods of sugar beet growing; planting dates and fertiliser placement with potatoes; weed control in carrots; and the establishment of good grazing leys under East Anglian conditions.

For the horticulturist there is information on better strawberry production. Other exhibits include labour-saving piggeries and inexpensive fencing. There will be examples of farm roads from local materials and demonstrations on making a concrete road.

The Northern Ireland Ministry of Agriculture's exhibit emphasises the importance of quality in marketing agricultural produce. Plant breeding and seed testing methods are explained at the stand of the National Institute of Agricultural Botany, and an exhibit of cider making has been arranged by Long Ashton.

German Agricultural Society

The 1951 German Agricultural Show, with a very high attendance of 700,000 visitors, proved to be a great success and gave an excellent picture of the efforts of the farmer of the West.

The variety of exhibits and the methods of showing were up to pre-war standard and quite astonishing for a country only just beginning to recover from the ravages of war. Some of the organisers who had been present seemed to have been influenced by last year's Oxford Show.

As is usual at agricultural shows, the machinery section was the larger, and was organised very efficiently. The exhibits were arranged in special groups, comprising tractors, threshing machinery, drills, seed cleaning machinery, etc. Owing to the lack of young skilled workers, whole generations of whom are missing, the labour problem is steadily increasing, so that the mechanisation of German agriculture increases proportionately at a rate that seems almost too rapid.

An immense variety of tractors were shown, the number of which might well have been reduced; Lanz, Deutz, Allgaier, Hanomag and innumerable smaller factories exhibited several different types. The general tendency, however, is towards Diesel engines.

The idea of mounting the cutter bar in a side position on the tractor—already known in England—has only just been introduced and there is also a trend towards mounting implements on the front rather than on the back of the machine. This means that not only is more precise work possible, but that, at the same time, there is room and power for fixing other implements to the back of the tractor.

The construction of combine harvesters is just beginning. Dechentreiter showed a new tractor-driven harvester and Fahr a self-propelled machine. Different types of balers combined with thresher and pick-up were exhibited, such as the efficient Welger baler. Straw-cutting has been introduced and Isaria showed a new small grass tedder with PTO drive, which enabled it to function on both sides. In a strong display of seed cleaners and graders the most remarkable was the new Petkus. In this machine the seed is transferred from the hopper to the grader by a new suction system, grading being done by sieves. The pre-cleaned seed is then graded by means of another suction device. An indented cylinder rejects the round seeds.

Plant breeders and the fertiliser and pest-control industries also showed some very interesting exhibits.

(From a correspondent)

Report on the Congress of the International Commission of Agricultural Engineering

The International Commission of Agricultural Engineering (C.I.G.R.) convened an international congress on agricultural engineering which was held under the auspices of the Italian Ministry of Agriculture and Forestry in Italy from April 22 to May 4, 1951, the purpose of which was to provide an opportunity for agricultural engineers, (a) to discuss the results of studies so far accomplished by individual members; (b) to discuss agricultural engineering problems and to agree on the procedure to be adopted for their solution; (c) to decide on plans for future activities; (d) to inspect agricultural engineering achievements in Italy.

On April 24 a meeting was held in Milan for the purpose of deciding the general policy to be followed by the C.I.G.R. and to discuss details of the agenda for the meetings in Rome.

An inspection visit was paid to the S. Giuliano Milanese estate with the ' Marcite ' irrigation system. These famous ' Marcite ' are permanent meadows giving eight to twelve grass cuttings a year. The meadows are roof-shaped and have a central irrigation ditch at their highest level and ditches for collecting surplus water at their lowest level. They provide continuous irrigation with sewage of about 12 degrees by overflowing in thin layers from November until early March in order to prevent frost in the winter season, whereas from spring to autumn only occasional irrigation is practised. Therefore the grass is cut most frequently during the winter season.

The following day delegates inspected reclamation works of the ' Bonificazione Parmigiana-Moglia,' covering an area of approximately 74,000 hectares between Boretto on the River Po, Moglia near the River Secchia and Modena. The purpose of this reclamation work is the irrigation of the zone, water being derived from the River Po at Boretto in quantities of 27.5 cu. mm. per second. The power station and irrigation channels were built in the period from 1928 to 1938. A further pumping station is now under construction in order to obtain additional water supplies amounting to 35 cu. mm. per second.

On April 27 the hilly reclamation works of the ' Bonifica Valdera ' in the province of Pisa were inspected.

The meetings in Rome were held on the F.A.O. premises at the Villa Borghese from April 28 to May 1, 1951. They were attended by 68 participants. The countries represented were: Belgium, France, Germany, Italy, Morocco, the Netherlands, Portugal, Spain, Switzerland, Turkey and the United Kingdom. Of the specialised agencies, F.A.O. was represented.

With a view to furthering its good relations with F.A.O., C.I.G.R. has offered to become the consulting engineer of F.A.O. and, as such, to study technical problems, the solutions of which are important for the realisation of the working programme of F.A.O. To facilitate this task, the representative of F.A.O. has been invited to attend all C.I.G.R. meetings, even if they are for C.I.G.R. members only. C.I.G.R. has decided to make every effort to gain further countries as its members so as to become more and more a liaison centre of the representatives of the most important agricultural engineering institutes, particularly in Europe. Therefore C.I.G.R. decided to accept as members the delegates from Germany and Turkey.

In order to avoid the overlapping of its work with that of other international organisations, C.I.G.R. decided to concentrate all work on the purely engineering matter of land and water utilisation, rural buildings, farm machinery and scientific organisation of work.

In response to a suggestion made by F.A.O., C.I.G.R. had made enquiries on the methods used for the testing of tractors by the main testing stations all over the world and prepared a report on the subject for discussion at the Congress. After this matter was discussed in detail, the opinion was expressed that two kinds of tractor tests have to be distinguished, one to assist the development of tractors and the other designed to give useful data for the information of the farmer. Further, the opinion was expressed that there was a pressing need for standardising methods for the testing of farm tractors which would give comparable data for the information of the farmer, and that the Nebraska tractor tests should be taken as a basis and supplemented by additional data. Therefore a Working Party was appointed consisting of experts from Belgium, France, Germany, Italy, Spain, Switzerland and the United Kingdom. It will be the task of this subcommittee, with Mr. Lemierre as secretary, to work out specific proposals on (a) the purpose of the test bulletin to be circulated as a comparable document and intended to supply information to the farmer, (b) the definition of basic factors, such as rated speed, effective power, efficiency, etc., (c) the method of measuring the different features with tolerances and adjustments, and (d) the arrangement of the bulletin so that the same data be grouped the same way.

Superphosphate Manufacturers' Annual Meeting

The International Superphosphate Manufacturers' Association held its annual series of meetings in Lucerne recently, at the invitation of the Swiss Manufacturers of Superphosphate, at which some 260 delegates were present from 20 different countries, including representatives of the industry from as far away as Australia, India and the U.S.A.

For the year 1951-52 the following officers were elected or re-elected:

Mr. R. Standaert (Belgium), President.

Mr. R. Audouin (France), Mr. A. Bloembergen (Holland), Mr. J. Capelo (Spain), Mr. B. Colbjornsen (Sweden) and Mr. H. Stevenius-Nielsen (Denmark), Vice-Presidents.

Mr. R. M. Collins, Secretary.

A series of Technical Meetings will be held in Paris next September, at the invitation of the French members.

Technical Adviser for South Africa

We are informed that Lt.-Col. W. N. Bates, A.M.I.Mech.E., M.I.B.A.E., is to take up an appointment in South Africa as Resident Overseas Technical Advisor to a group of British agricultural machinery manufacturers.

His headquarters will be at Pietermaritzburg, capital of Natal and close to the South African sugar belt and Natal wattle growing industry. There he will be able to approach the problems of mechanisation on the spot and advise designers and manufacturers in Britain accordingly.

Col. Bates has for the last four years been personal assistant to the Chairman of the British Agricultural Machinery Manufacturers' Export Association (B.A.M.M.E.X.) in London. He will leave for South Africa towards the end of July.

Eelworm Control

Tests with DD (dichloropropylene-dichloropropane) and mercuric chloride against potato root eelworm, carried out by workers of the West of Scotland Agricultural College, have shown highly encouraging results, according to recent information from Scotland.

The most economic substance has been found to be DD solution, in spite of its cost of £15 to £20 per acre.

Positive results have been obtained over four consecutive years in Ayrshire, giving increased yields of field earlies worth double the cost of treatment.

WORLD CROP REPORTS

ENGLAND AND WALES

Agricultural returns. The estimated yields per acre of root crops in 1950 were better than in the previous year and also above the average of the ten years 1940-49. The yields per acre of corn and other crops were generally below those for the previous year but above the average of the ten years 1940-49.

The increased acreage of wheat resulted in an increase of 384,000 tons (18%) over the 1949 production, but the acreage and production of barley and oats were lower. The yield per acre of potatoes was appreciably above average and production increased by 512,000 tons (8%) in spite of a smaller acreage. The yield per acre of sugar beet was nearly 40% above the ten-year average and resulted in a record production of over 5,000,000 tons of roots.

Up to and including 1949 the Ministry's estimate of production of hay included all mown grass, some of which was for silage or drying. The 1950 figures, on the other hand, relate only to hay as such and do not include estimates for grass silage and dried grass. The large apparent decline in hay production is explained partly by the exclusion in 1950 of grass silage and dried grass and partly by bad weather in 1950, which prevented many farmers from making as much hay as they intended. Detailed figures are given in the following table:

FINAL PRODUCTION ESTIMATES OF CERTAIN CROPS IN ENGLAND AND WALES FOR YEARS 1949 AND 1950

Crop	Acreage (a)		Estimated yield per acre		
	1949	1950	Ten-year average 1940-49	1949	1950
	Acres ('000)	Acres ('000)	Cwt.	Cwt.	Cwt.
Wheat	1,899	2,398	19.1	22.4	21.0
Barley	1,885	1,624	17.8	20.6	19.0
Oats	1,945	1,833	16.8	19.0	17.5
Mixed corn	669	824	16.7	19.1	17.1
Rye (threshed)	60	67	14.5	17.2	16.4
Beans for stock-feeding	102	109	14.3	16.0	17.5
Peas	35	36	13.3	13.8	13.6
			Tons	Tons	Tons
Potatoes	929	866	7.0	6.6	7.7
Sugar beet	408	415	9.3	9.5	12.9
Turnips and swedes for stock-feeding	337	299	12.5	11.4	14.3
Mangolds	265	266	19.5	19.4	23.8
			Cwt.	Cwt.	Cwt.
Linseed	58	38	(d)	7.9	7.6
Hay from Lucerne	(c)	39 (b)	(d)	(d)	48.0
Hay from other temporary grass	2,320	1,748 (b)	27.4	29.6	28.8
Hay from permanent grass	2,634	2,350 (b)	19.1	19.7	20.2
Wheat Straw	1,899	2,398	20.2	21.0	20.2
Barley "	1,885	1,624	14.8	16.3	15.7
Oat "	1,945	1,833	17.7	19.0	17.6

(a) June acreage after deducting acreage cut green or, in the case of roots, grown for seed.
(b) Acreage cut for hay.
(c) Included in temporary grass in 1949.
(d) Not available.

AUSTRALIA

Limited oilseed production. The Director-General of Agriculture says that State limitations on margarine production (imposed to protect the Australian butter industry) act as a brake on the production of vegetable oils in Australia. 'Only cottonseed and linseed are likely to be increased,' he adds, 'as cottonseed oil is important for defence purposes and linseed oil does not compete with the products of the dairying industry. Between 30,000 and 35,000 acres are now sown with linseed, and the acreage is steadily increasing. But it is estimated that about 200,000 acres are necessary to meet Australia's full requirements.' Cottonseed production fell to its lowest level during the last harvest, but to encourage production the Federal Government is guaranteeing farmers 9½d. per lb. for the new crop.

MEXICO

Coffee estimate. Total coffee production in Mexico from the 1950-51 coffee crop is estimated at about 1,065,000 bags, compared with around 950,000 bags in 1949-50, 1,100,000 bags in 1948-49 and a pre-war (1935-39) annual average of 959,000 bags, according to the American Embassy, Mexico City. High coffee prices have resulted in a decrease in Mexican coffee consumption to around 250,000 bags annually, therefore the 1950-51 harvest should provide about 815,000 bags of coffee for export to foreign markets.

About 96% of Mexico's coffee exports went to the United States in 1950, compared with 98% in 1949, 99% in 1948 and 62% in the pre-war period. Exports to Europe in 1950 amounted to 17,468 bags, compared with 3,689 bags in 1949 and a pre-war annual average of 228,747 bags.

ARGENTINA

Over-production of olive oil. Argentina has good prospects for producing some 14,000 short tons of olive oil annually in the next few years—over four times the 3,300 tons produced now. In fact, some observers forecast serious over-production by 1960 if olive tree planting continues at the present rate. They point out that Argentine annual imports and consumption of olive oil have declined sharply from the 55,000 tons or more before 1930 to an annual average of some 14,000 tons in the pre-war years 1936-40. During World War 2 yearly consumption, all from the domestic crop, was less than 1,100 tons.

Planting of olive trees in Argentina has increased sharply in the last decade. An official survey in July 31, 1948, determined that there were nearly 5,240,000 trees in the country. A more recent count has revealed that in 1950 there were nearly 6,740,000 trees. Thus 1,500,000 trees have been planted since 1948, an increase of roughly 30%.

The potential output of olives in another ten years, assuming a per-tree yield of about 28 lb. after a tree reaches an age of seven or more years, is estimated at 88,000 tons, more than four times the 1949-50 output. This would be more than sufficient to meet the annual pre-war consumption requirement of 14,000 tons of oil, assuming an oil yield of 18%, and would be more than enough for the 6,600 tons of green and ripe olives consumed each year.

Nearly half of the olives are produced in Mendoza Province.

PAKISTAN

Final Jowar forecast. The revised final forecast of the area under Jowar (Indian millet) in Pakistan for the year 1950-51 is 1,265,000 acres, as against 1,192,000 acres reported in the final forecast of 1949-50. A large part of the 6.1% increase has occurred in the Punjab, which is attributed to timely rains at sowing. The revised final forecast of the yield of this crop for the year 1950-51 is 238,000

tons, as against 217,000 tons reported in the final forecast of 1949-50, an increase of 9.7%.

Rape and mustard. The revised second forecast of the area under rape and mustard in Pakistan for the year 1950-51 is 1,487,000 acres, compared with 1,483,000 acres reported in the second forecast of the previous year. The acreage reported in the final forecast of the previous year was 1,432,000 acres. There has been an increase in the acreage of this crop in Sind, Baluchistan and Khairpur State, which is attributed to high prices of oils and oilseeds. This increase is, however, largely offset by the decrease in the Punjab, Bahawalpur State, North-West Frontier Province and East Bengal.

Drop in barley area. The second forecast of the area under barley is 594,000 acres, as against 682,000 acres reported in the second forecast of the previous year. The area reported in the final forecast of the previous year was 562,000 acres. The decrease has occurred mainly in the Punjab and the North-West Frontier Province and is attributed to unfavourable weather conditions at the time of sowing.

Rice, slight decrease. The final forecase of the area under rice for the year 1950-51 is 22,329,000 acres, as against 21,781,000 acres of the previous year, and shows an increase of 2.5%. Except in the winter and summer rice crops of East Bengal, there was a general increase in the acreage of this crop throughout Pakistan. The final forecast of the yield of this crop for the current year is 8,137,000 tons of cleaned rice, as against 8,142,000 tons for 1949-50, and shows a nominal decrease of 0.1%.

The above figures are subject to revision in the light of information awaited from Sind and also from East Bengal for the summer crop.

Final maize forecast. The final forecast of the area under maize crop for the year 1950-51 is 942,000 acres, as against 1,004,000 acres for the previous year, and shows a decrease of 6.2%. Except in East Bengal and Baluchistan, there has been a general decrease in the acreage of this crop throughout Pakistan. The yield for the year 1950-51 is 368,000 tons, compared with 423,000 tons in the previous year, and shows a decrease of 13%. Except in Baluchistan, there has been a general decrease in the production of this crop.

1950-51 gram crop. The first forecast of the area under gram crop for the year 1950-51 is 2,804,000 acres, as against 2,712,000 acres reported in the first forecast of the previous year, and shows an increase of 3.4%. The acreage reported in the final forecast of the previous year was 2,741,000 acres. Except in the N.W.F. Province, Bahawalpur and Khairpur States, there is an increase in the acreage of this crop due to favourable weather conditions at the time of sowing. Also known as chunna, gram is a grain crop, the size of the grain being slightly smaller than a pea.

BRITISH WEST INDIES

Latest sugar production estimates. The following table, reproduced from Czarnikow's *Review*, shows the latest estimates of production for the quota year ending August 31, 1951, based on information received by the West India Committee. The total shows a slight decrease from the total estimate published in ' World Crop Reports ' two months ago, but still shows a considerable increase over 1949-50.

	1950-51 *Tons*	1949-50 *Tons*
Barbados*	173,000	158,182
Jamaica	279,530	271,582
Leeward Islands:		
Antigua	24,300	31,121
St. Kitts ..	44,000	41,204
Trinidad and Tobago	162,500	146,508
Windward Islands:		
St. Lucia ..	10,300	10,441
St. Vincent ..	2,700	2,758
British Guiana ..	189,406	195,651
British Honduras ..	1,800	1,600
	887,536	859,047

* Includes Fancy Molasses estimated at equivalent of 20,000 tons of raw sugar.

FRANCE

Weather reduces crops. The French Ministry of Agriculture has announced that the April frost and rain reduced crops of wheat, potatoes and green vegetables, and caused damage to vineyards in central France. All cereal and potato crops were from two weeks to a month late, green vegetables will be of a lower quality than last year, and the potato crop has been particularly hard hit.

Beet crops are not affected by the weather and pasture is in good condition. Milk production is expected to exceed 1950 figures.

PANAMA

Greater rice production. Panama's rice crop in 1950-51 is estimated at a new record of 190,000,000 lb. of rough rice. This is a 9% increase from the previous largest crop of a year earlier and is more than double the pre-war (1935-36/39-40) production, reports *Foreign Crops and Markets*.

Indications are that some rice may be available for export in 1951. The crop, however, will be used primarily for consumption within the country. Panama's *per capita* rice consumption of around 150 lb. annually is exceptionally high, compared with the average in the western hemisphere countries. This is due to the fact that rice is produced on approximately 80% of Panama's farms. Here it is grown first for home consumption and the remainder is sold to the Banco Agro-Pecuario, the Government marketing agency, and to private firms.

The rice production of Panama in the last two years has been sufficient for domestic consumption. Imports of rice before 1949 averaged around 10,000,000 lb. annually. The increase in production, accomplished by concerted Government and private enterprise, is attributed to (1) a heavy import duty in some years which raises the retail price of rice above the world price basis, and (2) the use of power machinery and artificial driers by several large growers who have recently entered rice production.

INDONESIA

1950 copra exports. Exports of copra during 1950 amounted to approximately 240,000 tons, which was about 20% less than in 1949. Exports to the Netherlands were practically unchanged, but exports to the United States and Great Britain were nil compared with 13,000 and 42,000 tons respectively in 1949. This decrease was largely due to an increasing use in Indonesia of fats produced from copra.

The copra export figures for January amounted to 27,181 tons, of which 17,529 went to Holland, 1,524 to Switzerland, 5,080 to Sweden and 3,048 to France.

GERMANY

More tobacco estimated last year. Western Germany's 1950 tobacco crop is estimated at about 25% above 1949. The 1950 leaf harvest is estimated at about 63,900,000 lb. on a green weight basis, compared with 50,700,000 lb. in 1949. The area planted to tobacco in 1950 totalled 27,181 acres compared with 22,239 in 1949. Average yield per acre in 1950 is placed at 2,352 lb. compared with 2,280 lb. in 1949.

NIGERIA

Cotton re-estimated. According to Barclays Bank *Overseas Review*, it is considered that the previous cotton crop estimate of 80,000-100,000 bales, based upon the amount of seed distributed, will not now be realised. A revised figure is given as 70,000 bales, as against 57,000 bales for the previous season.